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1975-1976
BULLETIN OF
DUKE UNIVERSITY

School of Forestry and Environmental Studies

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School of Forestry and Environmental Studies

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University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
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Olan Lee Petty, Ph.D., *Director of Summer Session*
Rufus H. Powell, LL.B., *Secretary of the University*
Charles Linn Haslam, J.D., *University Counsel*

School of Forestry and Environmental Studies Administration

Charles William Ralston, M.F., Ph.D., *Dean of the School of Forestry*
Fred Myerle White, M.F., *Director of the Duke Forest and Assistant to the Dean*
Robert Lloyd Barnes, M.F., Ph.D., *Director of Admissions*
Roger Fabian Anderson, M.S., Ph.D., *Director of Graduate Studies in the Department of Forestry of the Graduate School*

School of Forestry and Environmental Studies Faculty and Staff

Roger Fabian Anderson (1951), M.S., Ph.D., *Professor of Forest Entomology*
Robert Lloyd Barnes (1965), M.F., Ph.D., *Professor of Forest Biochemistry*
Leon Edward Chaiken (1952), M.F., *Professor of Forest Management*
Frank J. Convery (1971), M.S., Ph.D., *Assistant Professor of Natural Resource Economics*
Henry Hellmers (1965), Ph.D., *Professor of Botany*
Frederick Charles Joerg (1947), M.B.A., *Professor of Forest Management*
Kenneth Richard Knoerr (1961), M.F., Ph.D., *Professor of Forest Meteorology*
Jane Philpott (1951), Ph.D., *Professor of Botany and Professor of Wood Anatomy*
R. Rajagopal (1974), M.E., Ph.D., *Assistant Professor of Quantitative Science*
Charles William Ralston (1954), M.F., Ph.D., *Professor of Forest Soils*
William James Stambaugh (1961), M.S., Ph.D., *Professor of Forest Pathology*
Arthur L. Sullivan (1974), M.S., Ph.D., *Assistant Professor of Regional Land Use Planning*
Fred Myerle White (1959), M.F., *Assistant Professor of Silviculture*
John Francis Williams III (1973), M.F., *Lecturer (part-time)*
James Edward Wuenscher (1970), M.S., Ph.D., *Assistant Professor of Forest Ecology*
David Owen Yandle (1967), M.S., Ph.D., *Associate Professor of Forest Mathematics*

Associate Faculty

Donald J. Fluke, Ph.D., *Professor of Zoology*
Aubrey W. Naylor, Ph.D., *Professor of Botany*

Adjunct Faculty

Edgar W. Clark, Ph.D., *Adjunct Associate Professor of Forest Entomology*
Milton S. Heath, Jr., LL.B., *Adjunct Professor of Environmental Law*
Charles S. Hodges, Jr., M.F., Ph.D., *Adjunct Associate Professor of Forest Pathology*
Louis J. Metz, M.F., Ph.D., *Adjunct Associate Professor of Forest Soils*
Fred M. Vukovich, Ph.D., *Adjunct Associate Professor of Forest Meterology*

Staff

Patricia S. Rorie, *Recorder and Secretary to the Dean*
E. Otto Griffin, Jr., *Superintendent, Duke Forest*
Edwina Johnson, B.S. in L.S., *Librarian, Forestry-Biology Library*
Sue P. Hicks, *Secretary, Duke Forest*
Nancy A. McMannen, *Secretary*
Jo W. Russell, *Secretary*

Faculty Emeriti

Ellwood Scott Harrar, Ph.D., *James B. Duke Professor Emeritus of Wood Science*
Paul Jackson Kramer, Ph.D., *James B. Duke Professor Emeritus of Botany*
James Granville Osborne, B.S., *Professor Emeritus of Forest Biometry*
Albert Edward Wackerman, M.F., *Professor Emeritus of Forest Utilization*
Frederick Adolphus Wolf, Ph.D., *James B. Duke Professor Emeritus of Botany*

School of Forestry and Environmental Studies Calendar 1975-1976

1975

June	
16	Monday—Registration for summer session
17	Tuesday—Classes begin
August	
15	Friday—Summer session ends
25-28	Monday-Thursday—Consultation with advisers and registration of new students
September	
2	Tuesday—Fall semester classes begin
November	
26-28	Wednesday-Friday—Thanksgiving Holiday
December	
1	Monday—Classes resume
10	Wednesday—Fall semester classes end
13	Saturday—Final examinations begin
20	Saturday—Final examinations end

1976

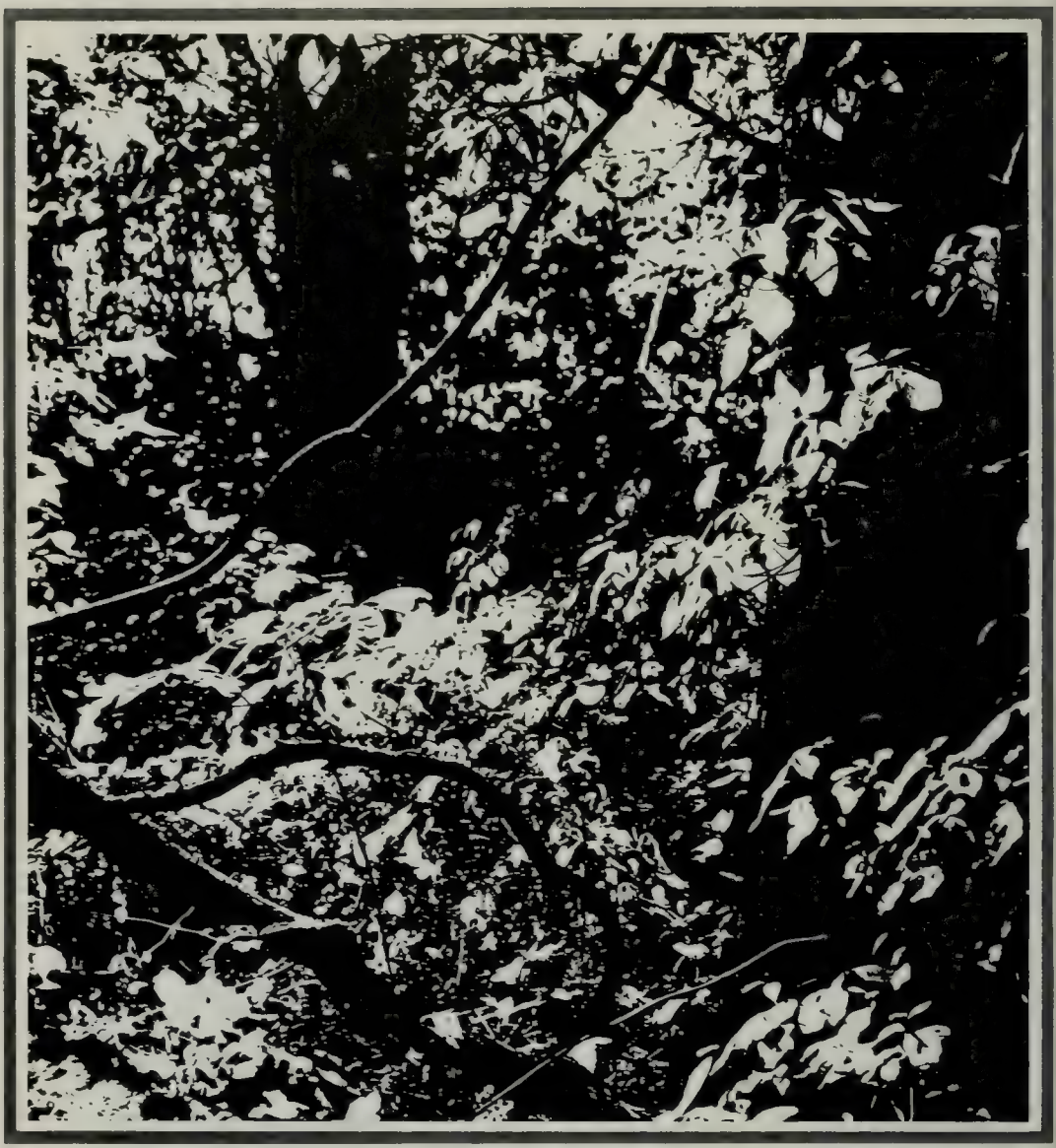
January	
12-14	Consultation with advisers for new students
15	Thursday—Registration and matriculation for all students who have not preregistered in the School of Forestry and Environmental Studies
19	Monday—Spring semester classes begin
March	
15-19	Monday-Friday—Spring break—spring field trips
April	
30	Friday—Spring semester classes end
May	
4	Tuesday—Final examinations begin
11	Tuesday—Final examinations end
16	Sunday—Baccalaureate and Commencement











General Information

Duke and the School of Forestry and Environmental Studies

Duke University, located at Durham, North Carolina, comprises Trinity College of Arts and Sciences, the School of Engineering, the Graduate School, and the professional schools of Forestry and Environmental Studies, Divinity, Law, Medicine, Business Administration, and Nursing. The University dates from 1838, when Union Institute was founded in Randolph County by the Methodists and Friends. In 1851 the institution became Normal College, one of the first schools in America for the training of teachers. In 1859 the name was changed to Trinity College by which it was known for sixty-five years.

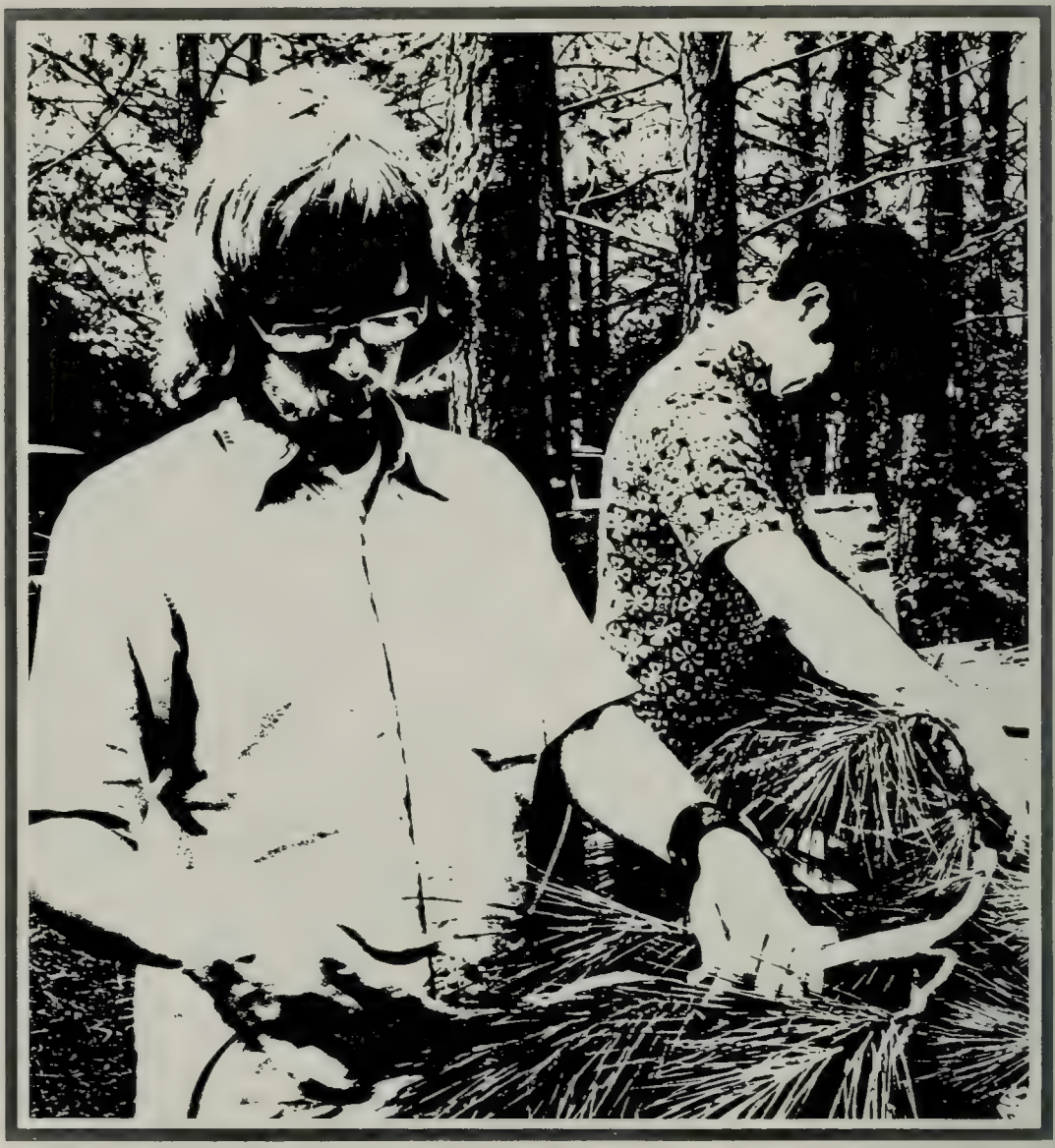
Then on December 11, 1924, James Buchanan Duke executed the Indenture of Trust that provided for hospitalization, church work in rural communities, and education. The principal feature of the educational provision was the creation of Duke University.

Now, the University, with a student body totaling 8,000, occupies two campuses. The East Campus of 108 acres was formerly the campus of Trinity College. About a mile west are the newer units of the University, known as the West Campus, totaling 467 acres. It was first occupied in September, 1930.

Forestry at Duke University began early in 1931 when the Duke Forest was placed under intensive forest management and forestry research was initiated. An academic-forestry curriculum, designed for men and women intent upon pursuing forestry as a profession, was organized in Trinity College of Duke University in 1932. This program was enlarged in 1952 and now includes more than sixty cooperating colleges and universities. (See pages 16-17).

In 1938 the School of Forestry was organized at the graduate level and a curriculum was offered leading to the degree of Master of Forestry. Work leading to the degree of Doctor of Forestry has been offered since 1940. In 1969 the School began responding to demands for individuals with professional expertise in environmental management by developing curricula in this growing field. Graduates of these programs have been awarded the Master of Environmental Management degree since 1975. The School has been fully accredited since its origin. A degree in forestry or environmental studies at the undergraduate level is not offered at Duke University.

Graduates of recognized colleges, universities, professional schools of forestry, and other students who meet the entrance requirements of the School (see page 19) may enroll in forestry programs leading to the professional degrees of Master of Forestry, Master of Environmental Management, and Doctor of Forestry. The Department of Forestry and Environmental Studies in the Graduate School also offers graduate work in certain aspects of forestry leading to the degrees of Master of Science and Doctor of Philosophy. This work is available to graduates of schools of forestry of recognized standing and to college or university graduates holding a bachelor's degree. All applicants will be considered without regard to race, color, religion, sex, or national origin.



Program Information

Related Fields

Basic scientific or professional programs of study are available in the following fields of forestry and related natural resources. Interdisciplinary programs between fields within the School of Forestry and Environmental Studies and those in other departments of the University also are possible and strongly encouraged.

Biological Science	Environmental Science
Forest Ecology	Forest Soils
Tree Physiology and Biochemistry	Forest Meteorology and Biometeorology
Forest Pathology	Wildland Hydrology
Forest Entomology	
Dendrology and Wood Anatomy	

Statistics and Operations Research	Economics and Management
Biometry and Statistics	Natural Resources Economics and Policy
Mensuration	Forest Management
Operations Research	

With the exception of forest management, study in all of the above fields can be pursued in programs for a M.S., A.M., or Ph.D. degree in the Department of Forestry and Environmental Studies of the Graduate School, or in a professional program for a M.F., M.E.M., or D.F. degree from the School of Forestry and Environmental Studies. Students contemplating careers in teaching and research are strongly urged to follow courses of study in the Department of Forestry and Environmental Studies in the Graduate School.

In addition, the following special management or business-oriented programs of study leading to the M.F. degree are available in the School of Forestry and Environmental Studies: Post-Liberal Arts and Science Program, Business Management Program, Forest Protection Program, Cooperative Forestry Program, and Natural Resource Ecology and Environmental Management Program for the M.E.M. degree.

Detailed information on these special programs is given under the Master of Forestry Degree, Master of Environmental Management Degree, and the Cooperative Plan of Study section in this *Bulletin*.

Master of Forestry Degree

The requirements for the degree Master of Forestry (M.F.) are governed by the extent of the student's previous undergraduate education, both in professional and related subjects, and by his specific career objectives. Usually, students who have earned the degree of Bachelor of Science in Forestry, or the equivalent, from an accredited school of forestry may complete the requirements for the M.F. degree in one academic year. Students with no prior preparation in forestry are required to begin their studies with a summer term of eight weeks. Thereafter, four semesters of study are required under this program for attainment of the M.F. degree. Graduate work of equivalent grade done in residence at other institutions may, with the approval of the faculty, be accepted as credit toward the degree, but a minimum of one year of residence at Duke University is required.

A student who has not completed his thesis while in residence must submit an acceptable manuscript to the faculty within a period of two years following the termination of his residence.

No student may take less than 14 nor more than 18 units of credit per semester without special permission of the faculty (see pages 23-24).

Postliberal Arts and Science Program. Men and women who are college graduates but have had no prior professional forestry training may be admitted to programs of study leading to the degree of Master of Forestry. Depending on the program of study, 60 to 70 units of credit in residence are minimal requirements, including the summer session and core courses listed below. In the case of students with advanced preparation equivalent to these specific subjects, total unit credit requirements may be reduced. Such reductions will be approved on an individual basis and only with specific recommendation of the student's major program adviser and approval by the faculty.

Summer Session

	Units
Careers in Natural Resources (For. 200)	0
Tree Growth and Development (For. 205)	3
Dendrology (For. 241)	3
Forest Measurements (For. 256)	4
Interpretation of Aerial Photographs (For. 289)	2

Core Courses

Soils and Forest Resources (For. 261)	3
Natural Resource Ecology (E.S. 243)	3
Resource Economics and Policy (For. 269)	3

During the latter part of the first year, each student will be requested to designate the field (or fields) he wishes to pursue for a major. After the student has designated his field of interest, he will be assigned a faculty adviser who, in consultation with the student, will develop a program of study in a manner similar to that described under the Postprofessional Program (see below).

Any student who does not earn a grade of *E* or *G* in at least 6 units of work in the first academic year will not be permitted to enter into the work of the second year.

Postprofessional Program. Students with satisfactory undergraduate professional training qualify for advanced study and research in the various disciplines of forestry under this program. A specific study plan is developed for each student through consultation with a faculty advisory committee. For the student planning a managerial career in the general area of forest production (and where the Master of Forestry is planned as a terminal degree), his program of study usually consists of courses and seminars, with a major portion of the work concentrated in the area of the student's interests. For the student with research interest, the study plan is oriented within the subject matter field of interest toward the furtherance of a research career, or toward preparing him for academic training beyond the master's level.

A number of courses offered in other departments of the University are open to qualified students in the School of Forestry and Environmental Studies. One or more of these may be included in a student's study plan when considered advisable by his advisory committee.

A minimum of 30 units, in which the student must earn a grade of *E* or *G* in at least 6 units, are required for the degree of Master of Forestry under this program. Usually, 15 units of credit (including the thesis) must be earned in the School of Forestry and Environmental Studies.

Business Management Program. A specialized program is offered in the School of Forestry and Environmental Studies in cooperation with the Department of Economics to prepare forestry graduates for managerial careers in the business aspects of industrial forest land management or forest products. The program requires two years of study and training leading to the degree of Master of Forestry. It is open to selected students who have earned a bachelor's degree (or the equivalent) in general forestry, forest management, forest utilization, or wood science and technology, with the proper prerequisites, and who also have potential leadership qualities indicative of administrative and executive ability.

The general requirements of the program are as follows:

1. At least 10 courses (30 units) in economics and business administration or in closely allied fields.
2. Approximately 5 courses (15 units) in forestry which deal with principles of administration and decision-making.
3. Experience as paid managerial trainee with a cooperating firm for a period including the fall semester of the second year and the preceding summer.
4. A written analysis of some phase of the managerial operational of the organization with which the training period is spent.

A specific program of study, commensurate with each student's academic background and future goals, will be developed by the program advisory committee in consultation with the student. A sample list of suggested courses included in such a program of study is available upon request.

Students entering the program must meet the admission requirements of the School of Forestry and Environmental Studies and be approved by a committee representing the faculties of Economics and Forestry. The financial award benefits of the School of Forestry and Environmental Studies are available to applicants for this program (see pages 39-41). Application forms for admission and financial aid may be obtained from the Director of Admissions of the School of Forestry and Environmental Studies upon request.









Forest Protection Program. A combined program of specialization in entomology-pathology is available for students desiring career preparation in the applied aspects of forest insect and disease control. This program of study leads to the Master of Forestry degree. Students electing the program must hold either a bachelor's degree in general forestry or have equivalent preparation in the biological sciences.

The general requirements of the program are as follows:

1. A minimum of 28 units in forest entomology and forest pathology. With approval, credits in closely related disciplines may be substituted.
2. At least 12 units of courses and seminars dealing with managerial and statistical aspects of forest protection.
3. One summer of employment experience with a forest protection agency.
4. Organization, conduct, and report of applied research on a forest insect and/or disease problems (4 units).

Reasonable latitude will be permitted in selecting courses to accommodate specific needs and interests. Each program of study will be developed in consultation with the program directors. A list of recommended courses is available upon request.

Applicants for this program must meet the requirements of the School of Forestry and Environmental Studies and the approval of the program advisory committee. Application forms for admission and financial aid may be obtained from the Director of Admissions of the School of Forestry and Environmental Studies.

Master of Environmental Management Degree

The requirements for the Master of Environmental Management degree are governed by the extent of the student's previous undergraduate education and by his specific career objectives.

A student without prior education in environmental management will be required to complete the equivalent of four semesters of resident study (60 units) beyond the baccalaureate degree level, including the core courses given below. Graduate work of equivalent grade done in residence at other institutions may, with approval of the faculty, be accepted as credit for the degree, but a minimum of one year of residence at Duke University is required.

No student may take less than 14 or more than 18 units of credit without special permission of the faculty (see page 24).

Core Courses*

	Units
Natural Resource Ecology (E.S. 243)	3
Biometry (For. 250)	3
Computer Science in Natural Resources (For. 253)	3
Soils and Forest Resources (For. 261)	3
Resource Economics and Policy (For. 269)	3
Ecological Principles in Environmental Management (E.S. 341)	3
Environmental Management Seminar (E.S. 327-8)(1 unit per semester)	4
Natural Resource Law and Policy (Plan. 233 - UNC)	3

*Prerequisites: Introductory Biology and Introductory Economics must be completed before entering program or taken without credit after entering program.

Natural Resource Ecology and Environmental Management Program. A professional program is offered to students with career interests in the expanding fields of environmental management and protection. The basic objective of this program is to develop expertise in planning and administering the management of natural resources and the non-urban environment for maximum human benefits with minimum deterioration of ecosystem stability. Emphasis is placed on the ecosystem as the basic unit of natural resource management.

This program of study leads to the Master of Environmental Management degree and is open to students with a bachelor's degree in biological or environmental science or with training in other fields and a strong motivation toward an ecological approach to natural resource problems.

General requirements of the program are:

1. A minimum of 24 units in resource ecology and environmental science.
2. At least 9 units in courses dealing with statistical or mathematical analysis of natural resource problems.
3. A minimum of 15 units in courses in resource use planning, business, and public administration.
4. Formulation, analysis, and report of research on an applied problem related to ecological or environmental aspects of natural resource management.

Although all students are expected to have substantive knowledge of principles of resource ecology, environmental science, and quantitative analysis, reasonable latitude is permitted in electing courses to meet the interests and capabilities of individual students. Each program of study will be developed in consultation with the program directors.

Application forms for admission and financial aid may be obtained from the Director of Admissions of the School of Forestry and Environmental Studies.

Program in Tropical Forestry. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section titled Organization for Tropical Studies in the *Graduate School Bulletin* in the chapter Special and Cooperative Programs.



Master of Science Degree

Prerequisites. The degree of Master of Science (M.S.) is offered through the Department of Forestry and Environmental Studies in the Graduate School. As a prerequisite to this degree a student must have earned a baccalaureate degree from an accredited college or university. There is no foreign language requirement for this degree.

Major and Minor Subjects. The work for the Master of Science degree is designed to provide a basic foundation in a fundamental area of forestry or in a field closely allied with forestry. A minimum of 30 units of credit is required for the degree; 24 units must be in formal courses although not more than 6 units can be earned for the thesis. Specific course requirements call for a minimum of 12 units in a major field of specialization and 6 units in a minor area of concentration. The major and minor fields are determined without regard to departmental divisions of the University if the interdisciplinary nature of the area of specialization makes such a program of study advisable. The specific program of study is developed by the major professor (thesis supervisor), subject to the approval of the Director of Graduate Studies in forestry and the Dean of the Graduate School.

The Thesis. At least one month before presenting the thesis, that is on or before February 1 for a May degree or on or before August 1 for a September degree, the student must file with the Dean of the Graduate School, on the official form, the title of the thesis and the declaration of intention to graduate. The title must have the approval of the thesis supervisor and the director of graduate studies in the major department. If the student has met the degree requirements before the above deadlines, he must file his intention to graduate one month before the thesis is presented.

All basic requirements for preparing the thesis are described in the *Manual of Style for Theses and Dissertations*, revised 1961, obtainable at the Duke University Book Store, West Campus. The quality of paper, form, and binding are prescribed in the *Manual*.

Four typewritten copies of the thesis, bound in snap binders supplied by the Library, must be submitted through the Graduate School Office to the Dean of the Graduate School on or before April 15 for a May degree or on or before August 15 for a September degree, and at least one week before the scheduled date of the student's examination. The copies will then be distributed by the student to the several members of the examining committee. Three copies for the library will be bound by the Ruzicka Bindery for a fee of $5.00 a volume. The student may request that an additional number of copies be so bound.

The Examining Committee and the Examination. The instructor who directs the student's program appoints an examining committee composed of himself and two other members of the graduate faculty, one of whom must be from a department other than that of the major. If the student has been permitted to take related work within the major department, the third member may represent the minor field within the department. This committee is submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

The student's committee administers the examination and certifies whether the student has passed or failed by signing the card provided for this purpose by the Graduate School Office. This card is used to indicate completion of all requirements for the degree. After a thesis is approved the committee

also signs all copies of the thesis, and the candidate then returns the original, the first two carbon copies, and any other copies he wishes bound by Ruzicka to the Dean of the Graduate School who deposits them in the University Library.

Master of Arts Degree

The degree of Master of Arts (A.M.) is offered through the Department of Forestry and Environmental Studies in the Graduate School. As a prerequisite to admission for this program, a student must have earned a baccalaureate degree from an accredited college or university. Students interested in working toward this degree should refer to the *Bulletin of the Graduate School* for specific requirements.

Doctor of Forestry Degree

The degree of Doctor of Forestry (D.F.) is a professional and research degree conferred upon those students who have satisfactorily completed specified requirements of advanced study and research.

Work toward the D.F. degree, consisting of advanced studies in a major and a minor field, is offered with majors in the several branches of forestry. A minor may be elected in forestry or in other areas of specialized study in the University approved by the faculty of the School of Forestry and Environmental Studies. Prospective students should correspond with the Director of Admissions of the School of Forestry and Environmental Studies on all matters pertaining to admission to the School.

Doctor of Philosophy Degree

The Doctor of Philosophy degree (Ph.D.) is conferred through the Graduate School of Duke University. Programs of study and research for men and women working for this degree are directed by faculty members of the School of Forestry and Environmental Studies who also comprise the graduate faculty of the Department of Forestry and Environmental Studies in the Graduate School. Both major and minor programs of study are available in the following branches of forestry: forest biochemistry, forest biometry, forest meteorology, forest ecology, forest economics, forest entomology, forest hydrology, forest pathology, forest soils, forest-tree physiology, and wood science including wood anatomy, and wood chemistry.

The Ph.D. degree is essentially a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. degree is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

General Requirements for the D.F. and Ph.D. Degrees

The formal requirements, discussed in detail below, for the doctoral degrees are as follows: (1) foreign language; (2) major and related courses; (3) supervisory committee for program of study; (4) residence; (5) preliminary examination; (6) dissertation; and (7) final examination. In order to be considered for candidacy for a doctoral degree, the student must have passed all of his course work in the first year of graduate study; on at least 9 units of course work in the first year, he must have made a grade of G or better.

Foreign Language Requirements. A reading knowledge of at least one foreign language is required for the D.F. and Ph.D. degrees. Languages usually taken are French, German, and Russian. Another language which has a definite relation to the degree program and for which an examination can be provided may be substituted for any of these with the approval of the supervisory committee.

A foreign student whose native language is not English may request that the director of graduate studies ask permission of the Dean of the Graduate School to offer English as the foreign language required in his program.

With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. may be waived in individual cases provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the student concerned.

The foreign language requirement(s) may be satisfied in the following ways:

1. The student may take the Educational Testing Service examinations at many national centers (including the Duke University Counseling Center). To avoid delays, prospective students are urged to take appropriate ETS Graduate School Foreign Language tests prior to registration. However, it should be noted that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language certificates more than six calendar years old will not be accepted toward fulfilling the language requirement.

2. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

Special Reading Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week. French is offered during the fall semester and occasionally also in the spring and German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses at any time. Undergraduates may not enroll during the academic year but may register, with permission of the Dean of the Graduate School, in the summer session if total registration permits.

Major and Related Work. The student's program of study necessarily demands substantial concentration on courses in his major department. It must, however, include a minimum of 6 units in related fields approved by his major department. Use of related fields within the major department requires the approval of the Dean.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and *not later than two months before the preliminary examination*, the director of graduate studies in the major department will nominate for the approval of the Dean a supervising committee of five, with one member designated as chairman. This committee will include at least three members of the major department and one from the minor department, if a minor is involved. This committee will approve the program of study, as well as administer the preliminary examination and the final doctoral examination. Should all members of the committee be from the major department, at least one member of another department will be added or substituted for the final

doctoral examination. The final examination may be administered with a minimum of four members.

When the preliminary examination is arranged, the committee and the director will submit to the Dean the student's program of study bearing a statement that the department's course and language requirements have been, or are being, completed.

Residence. The *minimum* registration requirement is 60 units of graduate credit, not more than 30 units of which may be accepted by transfer. Since a full program is 30 units per academic year, the prospective doctoral candidate who enters with an A.B. or B.S. degree must plan to spend in residence a *minimum* of two academic years; if he enters with an A.M., M.S., or M.F. degree, his *minimum* residence is one academic year. If there are undergraduate deficiencies in his program, he may, in addition to the minimum requirements, be required to take preliminary undergraduate courses for which he will not receive graduate credit. Even if there are no such undergraduate deficiencies, the student's supervisory committee will determine what requirements, if any, above the minimum the student must meet. See pages 23-24 for further information on registration in residence and *in absentia*.

When the preliminary examination is passed, any courses, language certifications, or other credits for advanced standing which are more than six calendar years old will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

Usually the student should pass the preliminary examination by the end of his second year of graduate study. If he has not passed it by the middle of the third year, he must file with the Dean a statement explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the end of the third year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the Dean for an extension of one year. Should this extension be granted and the dissertation not be submitted and accepted within the year, the student must pass a second preliminary examination to remain a doctoral degree candidate. In such a case, the time limit for submitting the dissertation will be determined by the Dean and the candidate's committee.

Preliminary Examination. A student is not accepted as a candidate for the doctoral degree until he has passed the preliminary examination. A transfer student who may have passed a preliminary examination elsewhere must, nevertheless, take the examination at Duke. The examination ordinarily covers both the major and minor fields.

In the summer, a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the Dean, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Failure on the second examination will render the student ineligible to continue his program for the doctoral degree at Duke University.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

Not later than February 1 (February 2, if February 1 falls on Sunday) preceding the May commencement at which the degree is expected to be conferred, the student must file with the dean of the appropriate school, on the official form to be obtained from the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation such as quality of paper, form, and binding are prescribed in the instructions for microfilming (see below) and in the *Manual of Style for Theses and Dissertations*, revised in 1961, which may be obtained from the Duke University Book Store, West Campus.

The dissertation must be completed to the satisfaction of the instructor who directs it. Four typewritten copies bound in snap binders secured through the Graduate School Office must be deposited with the dean of the appropriate school on or before April 1 preceding the May commencement when the degree is to be conferred. The dissertation must be submitted at least seven days before the scheduled date of the student's examination.

All doctoral dissertations usually will be published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may, if they wish, also copyright them. An abstract will be published in *Dissertation Abstracts*. Before final typing is completed, the candidate should obtain, in the Graduate School Office, detailed instructions on the procedure, together with a microfilming agreement which is signed and returned when the dissertation is finally deposited in the Graduate School Office.

In brief, all copies of the dissertation, the original in clean type, will remain unbound except for spring binders. Ten copies of an abstract, carefully written and not more than 600 words long, are submitted when the dissertation is first presented. A nonreturnable dissertation fee of $25 is charged for handling and microfilming. If copyright is desired, an additional fee of $7 plus 2½ cents per page is charged. The original and two carbon copies will be bound by the Ruzicka Bindery for a fee of $5 a volume. The student may request that more than the three copies be so bound.

Final Examination. The final oral examination shall be based primarily upon the dissertation. Questions may, however, be asked in the candidate's major field. Except in unusual circumstances, approved by the Dean, a final examination will be scheduled only when school is in session.

If a student fails his final examination, he may be allowed to take it for a second time, but not sooner than six months from the date of his first. Permission to take the second examination must be obtained from the instructor who directed the dissertation and from the Dean. Failure to pass the second examination renders the student ineligible to continue work for the doctoral degree at Duke University.



Cooperative Plan of Study

Program with Selected Colleges and Universities

Since its inception the Duke School of Forestry and Environmental Studies has had the cooperation of Trinity College (the undergraduate college of arts and sciences of Duke University) in preparing students for professional careers in forestry. Under the plan, a student devotes his first three years to a coordinated and carefully integrated program of study in the basic arts and sciences in Trinity College. The following five semesters are spent in the School of Forestry and Environmental Studies, and usually upon successful completion of 70 units of credit in a professional program of study, a student will have earned the Bachelor of Science degree from Trinity College and the professional Master of Forestry or Master of Environmental Management degree from the Duke School of Forestry and Environmental Studies. In the case of students with advanced preparation relevant to their specific educational objectives, total unit credit requirements may be reduced. Any such reductions will be approved on an individual basis and only with specific recommendation of the student's major program adviser and approval by the faculty.

Based upon the experience and success of this cooperative program with Trinity College, the School of Forestry and Environmental Studies in 1952 initiated similar programs of collaboration with a selected group of colleges and universities located throughout the United States. These programs offer students the numerous advantages of a broad background in liberal arts and sciences as preparation for later professional training. A student intent upon following such a course of study should make application to one of the colleges listed on pages 16-17. Admission requirements and other information pertinent to matriculation may be obtained from each of these institutions. Not later than the end of the first semester of the third year in the college or university of his choice, the student may make formal application for admission to the Duke University School of Forestry and Environmental Studies. To qualify for admission under these programs, a student must have followed a course of study arranged in consultation with his adviser, must have the official recommendation of his college, and must meet the minimum requirements for admission to the Duke School of Forestry and Environmental Studies.

Institutions in the Academic-Forestry Program

Alabama
- Samford University, Birmingham 35209

Arkansas
- Little Rock University, Little Rock 72204

Colorado
- Colorado College, Colorado Springs 80903

Florida
- Florida Southern College, Lakeland 33802
- Rollins College, Winter Park 32791
- Stetson University, College of Liberal Arts, DeLand 32720

Georgia
- Mercer University, Macon 31207

Illinois
- Illinois Wesleyan University, College of Liberal Arts, Bloomington 61710

Indiana
- Butler University College of Liberal Arts and Sciences, Indianapolis 46208
- Franklin College, Franklin 46131
- Indiana Central College, Indianapolis 46227

Iowa
- Iowa Wesleyan College, Mount Pleasant 52641

Kansas
- Baker University, Baldwin 66006

Louisiana
- Centenary College of Louisiana, Shreveport 71104

Maryland
- Western Maryland College, Westminster 21158

Michigan
- Albion College, Albion 49224

Mississippi
- Millsaps College, Jackson 39210

Missouri
- William Jewell College, Liberty 64068

Nebraska
- Doane College, Crete 68333

New Jersey
- Drew University, College of Liberal Arts, Madison 07940

New York
- Hofstra University, Hempstead, Long Island 11550

North Carolina
- Catawba College, Salisbury 28114
- Duke University, Trinity College, Durham 27706
- Guilford College, Guilford College 27410
- High Point College, High Point 27262
- Wake Forest University, Winston-Salem 27106

Ohio
- Baldwin-Wallace College, Berea 44017
- Denison University, Granville 43023
- Heidelberg College, Tiffin 44883
- Kent State University, College of Liberal Arts, Kent 44240
- Marietta College, Marietta 45750
- Miami University, College of Arts and Sciences, Oxford 45056
- Ohio University, Athens 45701
- Otterbein College, Westerville 43081
- Wittenberg University, Springfield 45501
- Youngstown State University, Youngstown 44503

Oregon
- Reed College, Portland 97202
- Willamette University, College of Liberal Arts, Salem 97301

Pennsylvania
- Albright College, Reading 19604
- Allegheny College, Meadville 16335
- Elizabethtown College, Elizabethtown 17022

Franklin and Marshall College, Lancaster 17603
Gettysburg College, Gettysburg 17325
Juniata College, Huntington 16653
Lebanon Valley College, Annville 17003
Lycoming College, Williamsport 17704
Moravian College, Bethlehem 18018
Muhlenberg College, Allentown 18104
Thiel College, Greenville 16125

South Carolina

Furman University, Greenville 29613
Newberry College, Newberry 29108

Tennessee

Carson-Newman College, Jefferson City 37760
Chattanooga, University of, College of Liberal Arts, Chattanooga 37403
East Tennessee State University, Johnson City 37602
Lincoln Memorial University, Harrogate 37752
Tennessee Wesleyan College, Athens 37303
Tusculum College, Greeneville 37743

Texas

Baylor University, College of Arts and Sciences, Waco 76706

Virginia

Bridgewater College, Bridgewater 22812
Randolph-Macon College, Ashland 23005
Richmond College—University of Richmond, Richmond 23173
William and Mary, College of, Williamsburg 23185

West Virginia

Davis and Elkins College, Elkins 26241
Marshall University, Huntington 25701
West Virginia Wesleyan College, Buckhannon 26201

Wisconsin

Beloit College, Beloit 53512





Admission

Master of Forestry or Master of Environmental Management Degrees

The admission requirements of the School of Forestry and Environmental Studies for work toward the Master of Forestry or Master of Environmental Management degrees presuppose that an applicant is either:

1. a graduate of a professional school of forestry, or
2. a graduate of a college or university of high standing, but without prior professional training in forestry, or
3. a student who has successfully completed three years of approved study at one of the colleges (listed on pages 16-17) cooperating with the School in the academic-forestry program.

Each applicant must present a certified transcript of his academic record showing the courses he has taken, the number of credit hours earned, and the grades received. Although specific courses are not required for admission, applicants must be aware that many fields within forestry require academic preparation of a specialized nature. Deficiencies, if any, may be satisfied in residence, possibly prolonging the time necessary to complete degree requirements. Students interested in specialized areas of forestry should write the Dean for advice as to specific preparatory courses.

An applicant who is a graduate of a professional school of forestry will present a certified transcript of his scholastic record. Before registering for the first semester of residence, students will be required to select the branch or branches of forestry in which they wish to concentrate the major part of their work and to prepare their proposed programs in conference with an appropriate faculty advisory committee. Ordinarily, graduates of a fully accredited school of forestry should be able to meet all requirements for the Master of Forestry degree in one full school year of resident study; others may require a longer period of residence. Two years of residence are needed to meet requirements for the Master of Environmental Management Degree.



Doctor of Forestry Degree

Admission to the School of Forestry and Environmental Studies for a program of study and research leading to the Doctor of Forestry degree is granted to a student who has received the Master of Forestry degree, or its equivalent.

An applicant must file a formal application for admission together with transcripts of his undergraduate and graduate academic records. In his application he should clearly state the branch of forestry in which he desires to concentrate and, if possible, his specific research interests.

The Director of Admissions of the School of Forestry and Environmental Studies, together with the prospective student's major adviser, will determine whether the qualifications of the applicant meet entrance requirements.

Master of Science and Doctor of Philosophy Degrees

Applications for admission into M.S. and Ph.D. degree programs in Forestry should be submitted to the Director of Admissions, Duke School of Forestry and Environmental Studies, for transmittal to the Office of the Dean of the Graduate School.

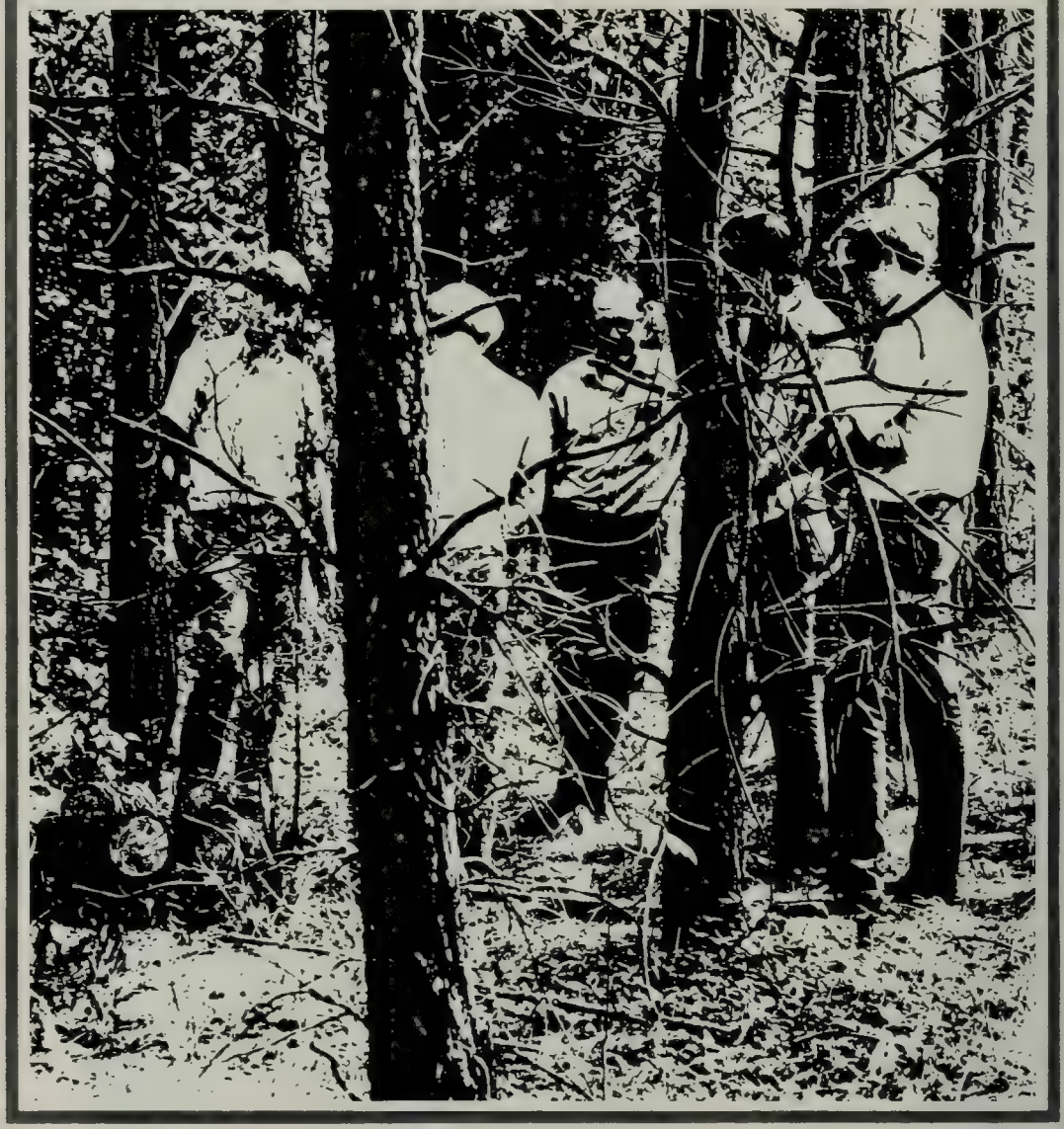
A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. His undergraduate program should be well rounded and of such quality as to give positive evidence of the capacity for graduate study.

Applicants for all degree programs of the School of Forestry and Environmental Studies will be considered for admission without regard to race, color, religion, sex, or national origin.









Registration and Regulations

Registration

All students who enter course work or residence for credit, all students who have completed minimum requirements for an advanced degree but continue to use the facilities of the University in their research, all students *in absentia* status, and all students who wish merely to audit a course or courses must register.

After the applicant has received notification of his admission to the School of Forestry and Environmental Studies and has returned his statement of acceptance of admission, he may present himself for registration. During the registration periods, announced in this *Bulletin*, he first confers with an assigned faculty adviser who prepares and signs a course card, listing the course work to be taken during the semester. The student then presents this course card to registration officials, who enroll him officially in his courses. After his first registration period as a current student he will preregister at the stated times for preregistration. Failure to preregister incurs the penalty for late registration. Former students who intend to register to resume a degree program must give the Director of Admissions notice of this intention two months before registration. A period of five weeks from the date of registration is provided for changes resulting from passing a preliminary examination.

Late Registration. All students are expected to register or preregister at the times stated in this *Bulletin*. Those registering late, including those who are obliged to register *in absentia*, are subject to a late registration fee of $10.

Change of Registration. During the academic year within a period of fourteen days from the registration date, a student may change registration with the approval of his adviser, if no reduction of fee is involved, and with the approval of the Dean if a reduction of fee is involved. During the first thirty days from the registration date, the only permissible change is dropping course-seminar registration and adding equivalent units of research, with the approval of his adviser, the instructor of the course, and the Dean.

Normal Registration. A graduate student is designated as fully registered when he registers for the maximum credit his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in completion of degree requirements. In the academic year normal registration for the resident student who does not hold an appointment as part-time instructor or assistant, or does not engage in part-time work, is 15 units a semester or 30 units an academic year. The normal registration for the student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties.

The resident student in a terminal master's degree program which requires no thesis carries normal registration until he has met all degree requirements. If a thesis is required and the student has met all requirements except for submitting his thesis, he registers for 3 units a semester while in residence or, if he elects to go out of residence, for 1 unit *in absentia* each semester until the thesis is accepted.

The resident student engaged in a master's degree program which is not terminal but preparatory to a doctoral program registers as though he were a doctoral student.

The resident student in a doctoral program carries normal registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units a semester until the dissertation is accepted. If, before or after passing the preliminary examination, he elects to go out of residence, he registers for 1 unit a semester *in absentia* in order to keep his program active.

It is necessary to be a fully registered student according to the regulations listed above (except when registered *in absentia*) in order to establish eligibility for library carrel and laboratory space, for student housing, for University and some outside loans, for the Student Health Service including voluntary insurance coverage.

The registration of 1 unit a semester *in absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health.

In the *summer session* 6 units a term is maximum registration. Students who are residents in the academic year and wish to continue study and the use of University facilities including Student Health during the summer must register for 1 unit in the first summer session term. This registration provides use of these facilities for all terms.

Academic Regulations

Transfer of Graduate Credits. Credit for graduate course work earned at another institution will be determined only after a student has spent one semester at Duke University. After completing his first semester, the student, through his director of graduate studies, should file a request that his credits be reviewed and a decision be made.

Grades. Grades in the School of Forestry and Environmental Studies are as follows: *E* (exceptional); *G* (good); *S* (satisfactory); *F* (failing); and *I* (incomplete).

An *I* (incomplete) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time grades are reported. The instructor who gives an *I* for a course specifies the date at which the student must make up the deficiency, in no case more than one calendar year from the date the



course ended. If the course is not completed, the grade of *F* is entered upon the student's record unless his appeal to the Dean for the grade *No Credit* is approved.

A grade of *F* in any course may result in withdrawal from a degree program.

Reciprocal Agreements with the University of North Carolina and North Carolina Central University. Under a plan of cooperation between the University of North Carolina and Duke University, students regularly enrolled in the Graduate Schools of the University of North Carolina during the regular academic year, and paying full fees to that institution, may be admitted to a maximum of two courses per semester in the Graduate School of Duke University upon payment of a nominal registration fee of two dollars and of any other special fees regularly required of all students. Under the same arrangements, students in Forestry and Environmental Studies and the Graduate Schools of Duke University may be admitted to course work at the University of North Carolina and North Carolina State University. A similar arrangement exists with North Carolina Central University at Durham.



Resources for Study

General and Research Facilities

The School of Forestry and Environmental Studies is housed in the south wing of the Biological Sciences Building on the West Campus. General and research laboratories are provided for routine and original studies in all of the subject matter fields. These laboratories are equipped with instruments and facilities for quantitative evaluation of biological materials and processes. Greenhouses and the phytotron adjoining the Biological Sciences Building and nearby Duke Forest offer excellent facilities for biological investigations in controlled and natural environments. An IBM system 370 Model 165 Digital Computer is available for processing research data via terminal facilities at the School.

Facilities of allied departments of the University are also available for advanced work in chemistry, economics, genetics, mathematics, plant anatomy, plant ecology, plant pathology, and plant physiology.

West Virginia Pulp and Paper Company has made available to Duke University a field headquarters for work in the forests of the South Atlantic Coastal Plain. This camp, located eighteen miles northwest of Summerville, South Carolina, is used as a base for field instruction in timber harvesting, wood utilization, soils, silviculture, and forest management.

The School periodically sponsors conferences and symposia on industrial forest management and other technical and scientific subjects. These offer the current viewpoints of many outstanding individuals both in forestry and in allied fields.

The University library, with 2,000,000 volumes and 4,000,000 manuscripts, provides exceptional resources and facilities for study and research by undergraduate and graduate students and by visiting scholars. About 80,000



volumes are added annually, and 164 foreign and domestic newspapers and 9,800 periodicals are received currently. Large collections of microfilms of rare books, newspapers, and periodicals are also available.

The Biology-Forestry Library, Chemistry Library, and Physics-Mathematics Library are housed for convenience in the buildings of these departments. The libraries of the Schools of Divinity, Law, Medicine, and Engineering are also housed in the buildings of these schools, all on the West Campus. The library on East Campus includes another 171,000 volumes.

The Duke Forest. The Duke Forest, of approximately 8,000 acres, is particularly well situated for field work. A five-minute walk from the campus will take one well into many parts of the area, and even the most distant portions can be reached by automobile in about twenty minutes.

At few others places in America are there provisions for extensive field study and research in forestry literally at the door of a large university. This

natural outdoor laboratory, so conveniently located and representative of the region, is a most valuable supplement to the instructional, laboratory, and library facilities of Duke University.

The forest lies mainly in Durham and Orange Counties near the eastern edge of the Piedmont Plateau. A cross section of much of the woodlands in the upper Coastal Plain and lower Piedmont of the Southeast is represented in the forest with its variety of topography, soil, forest conditions, and patterns of past land use. Elevations range from 280 to 760 feet. The soils are derived from such diverse parent material as metamorphic rock of the Carolina slate formation, granite, Triassic sedimentary rock, and basic intrusives. Nearly one hundred tree species are represented. Some eighteen miles of improved woods roads make all parts of these woodlands accessible. Duke Forest serves as an outdoor laboratory for instruction in forestry and allied fields, and as an experimental forest for research in problems of timber growing and in the sciences basic thereto. It is also used to demonstrate methods of silviculture and forest management applicable to the region.

Forestry Sciences Laboratory. The establishment of the Forestry Sciences Laboratory of the United States Forest Service's Southeastern Forest Experiment Station in the Research Triangle Park near Durham provides an unusual opportunity for complementing the research programs of students in the School of Forestry and Environmental Studies. Specialized research projects in forest entomology, pathology, and soils are currently under way at the laboratory. The research staff of the laboratory is available for consultation, participation in seminars, and service on graduate committees of students in the School of Forestry and Environmental Studies. Arrangements may also be made for students to conduct certain aspects of their research at the laboratory.

Phytotron. A controlled environment plant growth facility adjoins the Biological Sciences Building. The Duke phytotron contains fifty separately controlled environmental areas. In the chambers and greenhouses it is possible to reproduce any total environment in the world. Using this procedure, one can study the influence of many environmental factors on the growth processes of trees. The chambers accommodate trees up to six feet tall, the greenhouses even larger plants. The Duke phytotron is one of three such laboratories in the United States.

Duke Environmental Center. The Duke Environmental Center is an interdisciplinary University-wide organization for the encouragement and coordination of research and training in environmental subjects. The Center provides students access to coursework, research, and expertise in all departments of the University and outside agencies involved in environmentally related activities. It also sponsors environmental courses and seminars and maintains an environmental reading and reference room. Students in the School of Forestry and Environmental Studies may become affiliated with the Environmental Center through working with one of several forestry faculty members who are involved in center activities.

National Environmental Research Center. The Durham area has the greatest concentration of Environmental Protection Agency (EPA) offices and activities outside of Washington, D.C. The EPA National Environmental Research Center in the Research Triangle Park is the national center of air pollution research and regulation activities. This facility provides a unique opportunity for cooperative research and advanced training in air pollution and other environmental subjects.



Student Life at Duke

Living Accommodations

Housing. Duke University provides residence hall and apartment accommodations for single graduate and professional men and women. Duke University has a 500-unit housing facility known as Central Campus Apartments. The complex provides housing for married graduate and professional students, single undergraduate and graduate students, and single and married students in nondegree programs related to allied health.

For single students the efficiencies and one, two, and three bedroom apartments are fully furnished. The apartments for married students include a few furnished efficiences and a number of one, two, and three bedroom units in which the kitchen, living room, and first bedroom are basically furnished and equipped. Eligible married students will find the apartments provide economy and convenience yet allow them to introduce individual character by using furnishings and accessories they might own or purchase while at Duke.

The monthly rental rates for each type of apartment are lower than those offered on the current local housing market. For further information on these apartments, married and single students should write: Manager of Apartments and Property, Duke University, 217 Anderson Street, Durham, North Carolina 27706.

The University also will provide assistance to married graduate and professional students in locating suitable housing in Durham, where varied types of reasonably priced units are available.

The Graduate Center, near the Medical Center, and Town House Apartments house men and women enrolled on a full-time basis in the graduate and professional schools. Town House Apartments are located between East and West Campuses.

The Graduate Center houses 148 male graduate students, 56 female graduate students, and 117 female undergraduate students. Commons facilities on the main floor are shared by men and women.

Students are usually licensed to occupy graduate residential space for the academic year, but for no period less than a semester or specified term.

Duke University operates Town House Apartments primarily for graduate and professional school students. Others are housed in individual apartments if the interests of the University are served. There are 32 two-bedroom units, each furnished for three occupants. Two students occupy the master bed-



room with adjoining half-bath, and the third occupies a smaller bedroom. A living room, kitchen, and full bath complete the living arrangement. Additional features are air-conditioning and a swimming pool. The campus bus, serving all parts of the University, is accessible to the Town House Apartments. Students must pay their own utilities for each apartment.

The Department of Housing Management is prepared to assist the married graduate and professional school students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and duplex units are available in limited numbers from time to time.

Detailed information about University housing facilities for single students and the housing assistance program for married students will be provided upon request by the Department of Housing Management, Duke University, Duke Station, Durham, North Carolina 27706.

Rooms in residence halls and spaces in the Town House Apartments or other residential units may be reserved by applicants only if they have been accepted by the graduate or professional schools and after the required $50 residential deposit has been paid to the University. The initial residential deposit is required with the application and is held until the room or apartment is vacated. Application forms and detailed information on graduate housing will be mailed when the graduate or professional schools have notified the Department of Housing Management of official acceptance of the student. Single students may express a choice for the type of housing desired. Completed applications for rooms and apartments are to be returned with the required deposits to the Department of Housing Management, Duke Station, Duke University, Durham, North Carolina 27706. Assignment priority is established by the date completed applications and deposits are received in this office.

Regulations governing occupancy of rooms and apartments will be provided by the Department of Housing Management at the time application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

For the cost of housing, see the section on Financial Information.

Dining Service. The dining facilities on the West Campus include two cafeterias with multiple-choice menus, a snack bar, and the Oak Room where full meals and *a la carte* items are served. In the Graduate Center there is a cafeteria with multiple-choice menus and a coffee lounge where sodas and sandwiches are served.

Due to the large number served in the dining halls, it is not possible to arrange special diets for individual students. Special diets for those who are ill are served in the infirmary.

Services Available

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student enjoy his privilege of being a part of the University community. To serve this purpose, both the University Health Services Clinic and the University Infirmary are available for student health care needs.

The main components of the Health Service include the University Health Services Clinic, located in the Pickens Building on West Campus, and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. Residential staff personnel should be consulted whenever possible for assistance in obtaining emergency treatment.

The facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students.

To secure the benefits of the Student Health Program, a graduate student during the terms or semester in which the illness occurs, must (1) in the summer session term be registered for at least 1 unit research or 3 units of course work, (2) prior to completing minimum residence requirements, be registered for at least 9 units per semester.

Students are not covered during vacations, and their dependents and members of their family are not covered at any time.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for any and all services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

The Student Mental Health Service, under the direction of Dr. W. J. Kenneth Rockwell, is located in the Pickens Rehabilitation Building and provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse or spouse and child. Although participation in this program is voluntary, the University

expects all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke Plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from opening day in the fall. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

The Duke University Counseling Center. Through the counseling center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. A continuing program of research in the areas of counseling and testing is also carried on by the staff of the center.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with students about their future professional plans. Students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations are far easier to accumulate during the time a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year through the Placement Office for those students who have registered. Copies of academic records are released only with the permission of the individual.

Student Activities

Students new to Duke University are reminded that they are welcome to use such recreational facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, instrumental, drama, and religious groups.

Students are encouraged to maintain broad professional contacts by participation in the activities of the Society of American Foresters, the Forest Products Research Society, the national honorary scientific society of Sigma Xi, and other societies appropriate to their major field of study.

The social and business events of the Forestry Club provide opportunities for many pleasant extracurricular activities. An active organization of the wives of forestry students, the Forestry Dames, offers a regular schedule for social occasions of interest to this group.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as are currently in effect or, as from time to time, are put into effect by the appropriate authorities of the University.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations, or for conduct adjudged unsatisfactory or detrimental to the University.

Visiting Scholars

The libraries and, to the extent practicable, other facilities of Duke University will be made available to faculty members of colleges and universities who wish to spend a period of time on the campus in pursuit of their scholarly interests. No fees will be charged such visitors unless they wish to participate in activities for which a special fee is assessed. Room and board may be arranged for at the regular rate in the dormitories and dining rooms. Dormitory space is usually available during the summer months. Inquiries concerning residence for visiting scholars should be directed to the Dean of the Graduate School.



Financial Information

Tuition and Fees*

The following table shows the charges collected from all students for the year 1974-1975. All charges for each semester are due and payable, unless otherwise specified, at the time of registration and no student is admitted to classes until arrangements have been made with the Bursar of the University for the settlement of such charges. After the day of registration, no refund of tuition will be made except for involuntary withdrawal to enter the armed services or in accordance with established University policy.

Tuition, per semester	$1,375.00
Tuition, summer session, per unit	77.00
non-laboratory course	231.00
laboratory course	308.00
Spring field seminars	15.00 to 25.00
In Absentia Fee, per semester (when applicable)	91.00

Forestry students may obtain admission to all regularly scheduled University athletic contests held on the University grounds during the entire academic year by payment of an athletic fee of $25 per year, plus any federal taxes that may be imposed. This fee is payable in the fall semester.

Tuition Refund Policy. Tuition refunds are governed by the following policy:

1. In the event of death or a call to active duty into the armed services, a full tuition refund is granted.
2. In all other cases of withdrawal, students or their parents may elect to have tuition charges refunded or carried forward as a credit for later study, according to the following schedule:
   a. Withdrawal before the beginning of classes: full refund.
   b. Withdrawal during the first or second week of classes: 80 percent.
   c. Withdrawal during the third through fifth week: 60 percent.
   d. Withdrawal during the sixth week: 20 percent.
   e. No refunds after the sixth week.
   f. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

*Although these fees are based upon existing charges, they are subject to change.

Audit Fee. If a student registers and pays fees for 12 units or more, he may audit one course without charge. Should he be permitted to audit a second course or should he be registered for less than 12 units the audit fee is $40 per course.

Transcripts. A student may request transcripts of his academic record. A minimum fee of $2.00, payable in advance, is charged for a single copy. A charge of $ .50 will be made for each additional copy of the same order.

Debts

No records are released and no student is considered by the faculty as a candidate for a degree until he has settled with the Bursar for all indebtedness.

Living Accommodations

Housing Fee. The charge for each person in a double room for the academic year is $393 in the Graduate Center. A limited number of single rooms are reserved for returning students.

The fee for Town House Apartments is $617 per student for the academic year on the basis of three students to an apartment. Utility charges are not included in these fees.

Housing fees are subject to change prior to the 1975-1976 academic year. A $50 deposit is required on all reservations.

Refunds. The $50 reservation deposit will be refunded to students (1) whom the University does not permit to return, (2) who graduate, or (3) who request the refund prior to registration, thus indicating their intention not to return for the following semester. The reservation deposit will not be refunded to students who register but fail to enter the following semester on schedule.

Arrangements for refund of the $50 room deposit are described on the residential deposit.

For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

Dining Service Fee. The cost of the dining facilities discussed on page 33 will approximate $750, depending on the tastes of the individual.

Motor Vehicles

Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of $10.00 for each automobile or $5.00 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least $10,000 per person and a $20,000 per accident for personal injuries, and $5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Estimated Expenses for the Academic Year

The following table represents an estimate of a graduate student's basic expenses in the School of Forestry and Environmental Studies for the year 1974-1975. It should be noted, however, that this estimate does not include any allowance for travel, clothing, and other miscellaneous expenses, inasmuch as these costs will vary depending on the needs, habits, and tastes of the individual.

	Low	*Moderate*	*Liberal*
Tuition	$2750.00	$2750.00	$2750.00
Room-rent*	393.00	393.00	527.00
Board	700.00	750.00	800.00
Laundry	30.00	40.00	50.00
Books	50.00	65.00	100.00
Athletic Fee (Optional)	25.00	25.00	25.00
Spring field seminars	15-25	15-25	15-25

*In the Graduate Center.

Student Aid

A number of fellowships, scholarships, and assistantships are allocated to the School of Forestry and Environmental Studies for the encouragement and financial assistance of men and women who offer promise of becoming leaders in the fields. These are awarded to applicants of high character on the basis of scholastic ability as judged by previous educational performance, professional experience, personal references, and the Graduate Record Examination. Holders of the awards will pay tuition and such additional fees as are regularly required.

Fellowships. Stipends range from $2,300 to $4,000 per academic year. Each recipient must have previously completed work equivalent to that required at Duke University for a master's degree with a major in forestry, environmental studies, or in a related basic discipline. Students receiving fellowships will devote their time to an approved program of study and research in any of the branches of forestry, and they are expected to become candidates for the Doctor of Forestry or Doctor of Philosophy degree.

Remission of Tuition. Children of ministers in the North Carolina and the Western North Carolina Annual Conferences of the United Methodist Church may be eligible to receive a remission of the tuition charge for a maximum of eight semesters of undergraduate study at Duke University. Eligibility is met by the parent being in a regular pastoral appointment; when the parent is in a special appointment, eligibility will be determined on an individual basis depending upon the nature of the appointment. In all cases the decision of the University will be final.

Scholarships. Stipends range from $600 to $3,200 per academic year. Recipients will usually devote their time to an approved program of study leading to the degree of Master of Forestry, Master of Environmental Management, or Master of Science with a major in forestry.

Graduate Assistantships. Graduate assistantships have stipends ranging up to $4,000, depending upon available funds and upon whether granted for

the academic year only, or the academic year plus summer. Recipients will devote half time to research or other work of the School of Forestry and Environmental Studies. They will be permitted to enroll for not more than 24 units in an academic year in an approved program of study, or program of study and research.

Application for Awards. Any student admitted to the School of Forestry and Environmental Studies is eligible to apply for a fellowship, a scholarship, or an assistantship. Application for these awards may be made concurrently with the application for admission.

The general procedures and requirements for applying for any financial award in the School of Forestry and Environmental Studies are outlined below. Applicants should initiate the necessary action early to ensure that the required documents are filed with the Dean of the School of Forestry and Environmental Studies on or before February 1 prior to enrollment.

1. File award application. Form will be supplied by the School of Forestry and Environmental Studies upon request.

2. Furnish supporting documents as follows: (a) official transcripts of record of all previous college or university credits earned and (b) letters of reference from at least three persons familiar with the applicant's character, scholarship, and professional ability. (Documents offered in support of admission, if so designated, may also serve in support of the application for financial award.)

3. Complete the Aptitude Test of the Graduate Record Examination. Instructions and application for admission to this locally administered examination are available on most college campuses, from the Duke School of Forestry and Environmental Studies, or by writing the Educational Testing Service, Princeton, New Jersey. Applicants should plan to take this examination in January or earlier.

Notification of awards is made on March 15. In case vacancies occur, completed applications received after February 1 will be considered at a later date.

In every instance where a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or prospective graduate student and accepted before April 1, the recipient may resign his appointment without prejudice prior to that date by notification in writing to the Dean. However, an acceptance given or left in force after April 1 obligates him not to accept another appointment without first obtaining formal release from the Dean of the School.

Loans

Students who are enrolled as full-time degree candidates and who have satisfactory academic and citizenship records are eligible to apply for student loans.

Champion Paper Foundation Fund. This fund was established in 1971 by a grant of the Champion Paper Foundation in support of the School of Forestry and Environmental Studies. Students may apply for assistance from this fund through the University Student Loan Office.

University Student Loans. The Duke University Federally Insured Loan Program is one of four loan programs specifically designed to help Duke students to meet legitimate educational expenses.

The other loan programs are the National Defense Student Loan program and the restricted University loan programs supported by privately donated funds. We recommend a review of each program to determine the one best suited to the individual student's needs and resources.

Through Duke University, students qualify for loans under the Federally Insured Student Loan Program, which enables the government to assume risks for loans thus eliminating the collateral requirement. In addition, the loan is cancelled in the case of the death or total and permanent disability of the borrower.

The Duke University Federally Insured Loan Program allows the student to borrow up to $2,500 per year at 7 percent interest. Repayment begins twelve months after a student completes his education, and he will have a maximum of ten years following graduation or withdrawal from the University to repay the loan.

An interest subsidy is available from federal funds for all students who have demonstrated need through the Graduate and Professional School Financial Aid Service (GAPSFAS). In order to qualify for the interest subsidy from the government a GAPSFAS form must be submitted. Under the subsidy the federal government will make the interest payments accruing during periods of full-time study, military service, Peace Corps or VISTA.

Other Funds. In addition to local loan funds, Duke University participates in the student loan program established under the provisions of the National Defense Education Act of 1958. Repayment of these loan funds usually begins one year after the student terminates full-time study. Interest accrues at the rate of 3 percent per annum commencing one year after termination of full-time study. Upon completion of the period of grace of twelve consecutive months, the ten-year annual repayment period begins, and simple interest on the loan at the rate of 3 percent starts to accrue. At this point the borrower still has one additional year before his first annual payment becomes due. The first annual installment will, therefore, fall due twenty-four months after the borrower has ceased being a full-time student.

Special benefits to those teaching in nonprofit schools, colleges, and universities permit a portion of the loan to be cancelled, depending upon the length of teaching service.

Applications and complete details regarding the student loan program may be obtained by writing to the School of Forestry and Environmental Studies. In approving loan applications, the Student Loan Committee selects those students who, from the standpoint of character, scholastic attainment, personality, and degree of financial need, are deserving of this consideration. All applications for loans should be made before July 1 preceding the academic year in which the student plans to matriculate.



Courses of Instruction

General

For. 152. Conserving Natural Resources. Fundamentals of natural resource development, use, management, and protection based on principles of the natural and social sciences. 3 units. *Staff*

For. 200. Careers in Natural Resources. A weekly seminar which surveys the research and managerial career opportunities in all fields of renewable natural resources. Required of students in Academic-Forestry program. No credit. *Staff.*

Forest Biology

DENDROLOGY AND WOOD ANATOMY

For. 206. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations and for study of micro- and ultra-structures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. 4 units. *Philpott*

For. 241. Dendrology. Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisites: Biology 1-2 or equivalent. 3 units. *White*

For. 292. Microtechnique of Woody Tissue. Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 206 or equivalents and approval of instructor. (Offered alternate years on sufficient demand.) 3 units. *Philpott*

Related courses in other departments include—*Botany:* Anatomy, Systematics, Physiology; *Chemistry:* Organic Chemistry; *Civil Engineering:* Mechanical Behavior of Materials.

ECOLOGY

E.S. 243. Natural Resource Ecology. An introduction to modern ecology with emphasis on natural resource management. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: consent of instructor. 3 units. *Wuenscher*

E.S. 337. Ecological Analysis for Environmental Management. Methods of analyzing ecosystems for environmental impact assessment, land use planning, and other environmental management applications. Lectures, laboratory, and field work in use of maps, aerial photographs, and field surveys for interpretation of physiographic and biological characteristics of terrestrial ecosystems. Prerequisites: Environmental Studies 243 and 341 and consent of instructor. 3 units. *Sullivan and Wuenscher*

E.S. 340. Ecology and Land Use Planning. Consideration of the properties and processes of the natural environment as they relate to land use. Exploration of the biological, economic, legal, and social aspects of the application of ecological principles to the land use planning process. Prerequisites: Environmental Studies 341 and consent of instructor. 3 units. *Wuenscher*

E.S. 341. Ecological Principles in Environmental Management. Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Environmental Studies 243 or other substantive coursework in ecology. 3 units. *Wuenscher*

E.S. 346. Seminar in Environmental Policy. Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: Forestry 269 and Environmental Studies 341 or their equivalents and consent of instructor. 1 unit. *Convery and Wuenscher*

E.S. 347, 348. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and research topics related to the management and natural resources. 1 unit. *Knoerr and Wuenscher*

For. 354. Quantitative Analysis of Ecological and Environmental Systems. Study of quantitative methods for describing forest ecosystems. Analysis of characteristics and dynamic behavior of biological populations; development and evaluation of mathematical models for ecological, physiological, and environmental systems. Simulation techniques for ecosystem analysis will be considered. Prerequisites: Forestry 204, 253, 353 and Environmental Studies 243. 3 units. *Rajagopal and Yandle*

Related courses in other departments include—*Botany*: Ecology, Plant-Water Relations, Community Analysis and Classification, Principles of Plant Distribution, The Environment, Vegetation of North America, Evolution; *Zoology*: Animal Behavior, Vertebrate Zoology.

PHYSIOLOGY AND BIOCHEMISTRY

For. 205. Tree Growth and Development. Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. *Barnes*

For. 207. Chemistry of Wood Tissues. Composition of wood at the elemental, molecular, and macromolecular levels, both in woody plants and in processed woods. Distribution and properties of main components and methods of analysis. Prerequisite: organic chemistry or consent of instructor. 3 units. *Barnes*

For. 208. Physiology of Wood Formation. Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. *Barnes*

For. 305. Forest Biochemistry. Biochemistry applied to structure and function of woody plants and associated fungi and insects. Prerequisites: courses in plant physiology and chemistry. 3 units. *Barnes*

Related courses in other departments include—*Botany:* Anatomy, Plant Metabolism, Plant-Water Relations, Physiology of Growth and Development; *Biochemistry:* Introductory Biochemistry, Chemistry of Natural Products; *Chemistry:* Organic Chemistry, Chemical Instrumentation.

PATHOLOGY

For. 222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work, with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson and Stambaugh*

For. 223. Forest Pathology. Survey of major diseases of North American forests and their timbers, with emphasis on current literature. Field and laboratory study in diagnosis and infection biology. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 4 units. *Stambaugh*

For. 321. Phytopathological Technique in Forestry. Fundamentals of phytopathology as applied to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. *Stambaugh*

For. 322. Microbiology of Forest Soils. Qualitative and quantitative characterization of the microbial populations of forest soils, with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisite: consent of instructor; mycology or bacteriology is recommended. 3 units. *Stambaugh*

For. 385. Seminar in Forest Protection. Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. *Anderson and Stambaugh*

Related courses in other departments include—*Botany:* Mycology, Plant-Water Relations, Physiology of Growth and Development, Cytology, Genetics; *Chemistry:* Organic Chemistry; *Zoology:* Biological Nucleonics; *Biochemistry:* Introductory Biochemistry.

ENTOMOLOGY

For. 222. Biology of Forest Insects and Diseases. (See description under Pathology above.)

For. 225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of the materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 units. *Barnes*

For. 230. Forest Entomology. Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 3 units. *Anderson*

For. 233. General Entomology. Principles of morphology, metamorphosis, and taxonomy of insects. Prerequisite: one course in entomology or zoology, or consent of the instructor. (Offered alternate years on sufficient demand.) 4 units. *Anderson*

For. 331. Toxicology of Insecticides. Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. (Offered alternate years on sufficient demand.) 3 units. *Anderson*

For. 332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects, with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology, or consent of the instructor. 3 units; 4 units with laboratory. *Anderson*

For. 335. Entomological Research Techniques. Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. *Anderson*

For. 385. Seminar in Forest Protection. (See description under Pathology above.)

Related courses in other departments include—*Zoology*: Ecology, Systematic Zoology, Radiation Biology, Biological Nucleonics, Cellular Physiology, Invertebrate Embryology, Genetics; *Chemistry*: Organic Chemistry; *Biochemistry*: Introductory Biochemistry; *Botany*: Bacteriology; *Microbiology and Immunology*: Microbiology.

Environmental Science

E.S. 347, 348. Natural Resource Ecology—Environmental Management Seminar. (See description under Ecology above.)

SOILS

For. 261. Soils and Forest Resources. Origin, development, and classification of soils, with special emphasis on those developed in humid climates; morphological, physical and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2 and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. *Ralston*

For. 362. Forest Soil Physics. Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural char-

acteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. (Offered on sufficient demand.) 3 units. *Ralston*

For. 364. Soil Classification and Mapping. Classification of soils as natural bodies. Mapping of soils, land-use classes and forest-site classes; field study will be made of soil in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. *Ralston*

For. 366. Forest Soil Fertility. The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 261; analytical chemistry is recommended. (Offered on sufficient demand.) 3 units. *Ralston*

Related courses in other departments include—*Botany*: Plant-Water Relations, Physiology of Growth and Development; *Biochemistry*: Introductory Biochemistry; *Chemistry*: Chemical Instrumentation, Elements of Theoretical Chemistry; *Geology*: Sedimentary Minerals.

METEOROLOGY

For. 203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. *Vukovich*

For. 204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. *Knoerr*

For. 215. Air Pollution Meteorology. The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring, and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: Forestry 203 or equivalent. (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from North Carolina State University.) 3 units. *Staff*

For. 217. Environmental Instrumentation. Consideration of the physical basis for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems, including transducers, signal conditioners, and analog and digital recorders. Methods for obtaining and processing computer compatible records. Precision measurement and calibration techniques with primary and secondary laboratory standards. Two lectures and three laboratory hours per week. Prerequisite: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. *Knoerr*

For. 304. Atmospheric Turbulence and Diffusion. Bulk and molecular aspects of atmospheric turbulence; Navier-Stokes equations and the Reynold's stresses; mixing-length and statistical turbulence theories; similarity hypotheses; turbulent transfer and diffusion in adiabatic and diabatic atmospheres;

characteristics of turbulence in various scales of motion from the planetary to sub-inertial range. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) *Vukovich*

For. 306. Dynamics of Local Atmospheric Motion. Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale-forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves, and local modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) *Vukovich*

For. 344. Micrometeorology. Physics of the earth's surface environment, with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon-dioxide in relation to exchange processes within the biosphere; local circulation and eddy diffusion; principles of micrometeorological measurement. Prerequisites: Forestry 203, or equivalent, and calculus. 4 units. (Offered on sufficient demand.) *Knoerr*

Related courses in other departments include—*Mechanical Engineering:* Fluid Mechanics, Thermodynamics, Heat Transfer, Transport Phenomena, Boundary Layer Theory; *Mathematics:* Applied Mechanical Analysis, Numerical Analysis; *Chemistry:* Physical Chemistry, Chemical Instrumentation; *Botany:* Ecology, Plant-Water Relations.

HYDROLOGY

For. 216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of stream. Techniques and research methods used to control the hydrologic cycle, water quality, and water yield on wild lands. 3 units. *Hellmers*

For. 342. Hydrologic Processes. Physical processes of the hydrologic cycle, with emphasis on those processes which can be modified or controlled by watershed management. 3 units. (Offered on sufficient demand.) *Knoerr*

Related courses in other departments include—*Civil Engineering:* Hydrology, Incompressible Fluid Flow, Mechanics of Fluids; *Mechanical Engineering:* Transport; *Chemistry:* Physical Chemistry, Chemical Instrumentation; *Botany:* Ecology, Plant-Water Relations.

Resource Economics and Management

ECONOMICS AND POLICY

For. 269. Resource Economics and Policy. Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. 3 units. *Convery*

For. 270. Economics of Forestry. Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services; problems of the economics of the firm and industry, basic and peculiar to forestry, with special attention to the time dimensions of value; the role of forestry in the general economy, including attention to relevant institutional factors. Prerequisite: Forestry 269 or equivalent. 3 units. *Convery*

For. 271. Financial Management. Analysis of the problems of management of the financial affairs of the firm: working capital, long-term capital needs, including the development of an optimal capital structure, with attention to tax problems. 3 units. *Joerg*

For. 272. Business Policy. An integrating course where, through analysis of case problems from the top management viewpoint, the student is given practice in arriving at effective courses of action for the solution of business problems. 3 units. *Joerg*

E.S. 273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. *Convery*

For. 277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced-level course in nonmarket decision-making or Forestry 378 or its equivalent. 1 unit. *Convery*

378. Seminar in Forest Economics. Examination and discussion of the application of economic concepts in forestry; the potential contribution of economic analysis to private and public forest management; current research in forest economics. Prerequisites: Forestry 270 or consent of the instructor; advanced courses in economics and economic theory are desirable. 2 units. *Convery*

Related courses in other departments include—*Economics:* Economic Theory, History, and Systems; Economic Development, Planning, and Fluctuations; Economic Statistics; Monetary and Fiscal Theory and Institutions; International Economics; Manpower, Labor, and Population; Industrial Organization and Public Policy; *Business Administration:* Business Finance, Marketing, and Accounting.

MANAGEMENT

For. 210. Forest Utilization. Introduction to utilization in the managed forest and the principal wood-using industries. A one-week field seminar is an integral part of the course. 2 units. *Yandle*

For. 244. Theory and Practice of Silviculture. Principles governing establishment, treatment, and control of forest stands; natural and artificial methods of reproduction, intermediate cuttings, and cultural operations, with emphasis on the principal forest types of temperate North America. Field practice in silvicultural operations and study of managed stands. Prerequisite: Forestry 243 or equivalent. 2 units; 3 units with laboratory. *White*

For. 245. Management of Small Woodlands. Practical application of principles of forest management to small tracts. Field examinations, compilation of data, negotiations and actions for landowners in diverse market and tax situations. 3 units. *Williams*

For. 247. Forest Recreation and Landscape Management. Focuses on developing a methodology for the integration of forest recreation and management practices that enhance and preserve the visual characteristics of the land-

scape. Emphasis will be placed on (1) the recognition and appreciation of natural landforms and cultural landscapes, (2) the evaluation of important ecological and natural processes that further define the landscape and place limits on its use, (3) the interaction of factors influencing the potential recreational use of forest lands, and (4) an examination of potential criteria for use of forest lands, and (4) an examination of potential criteria for the evaluation of alternative management strategies. Prerequisite: consent of instructor. 3 units. *Chaiken and Wuenscher*

For. 248. Forest Regeneration. The fundamentals and application of forest tree improvement, nursery operations, and site-improvement techniques to the regeneration of forest stands by artificial and natural means. 3 units. *Chaiken and White*

For. 256. Forest Measurements. Application of plane-surveying technique to the measurement of land area, topography, and timber type; measurement of volume and growth of forest trees and stands; measurement of forest products. 4 units. *White*

For. 281. Forest Management. Principles of organizing forest properties for systematic management; use of data obtained in surveys and inventories; principles of forest regulation, including a study of normal and actual forests, rotations, cutting cycles, and methods of regulating the cut in even-aged and all-aged forests for sustained yield; introduction to the preparation of preliminary forest management plans. 3 units. *Chaiken*

For. 283. Fire Behavior and Use. Impact of destructive agencies upon forests; principles of combustion, fire behavior, danger measurement, and suppression; use of fire in forest management. 2 units. *Chaiken*

For. 289. Interpretation of Aerial Photographs. Principles of aerial photography and remote sensing as applied to forest administration, vegetation mapping, forest mensuration, and insect and disease surveys. Corequisite: Forestry 281 or equivalent. 2 units. *Chaiken*

For. 382. Legal Aspects of Forestry. A seminar on certain state and federal laws pertinent to the management of forests: land ownership, trespass, public liability, timber contracts, labor relations, and use of pesticides. 1 unit. *Chaiken*

For. 386. Seminar in Forest Management. Examination and analysis of techniques employed in the management of industrial and public forests, particularly in the South; discussion of problems of large scale intensive forest management. Prerequisites: Forestry 244, 281, and 377 or equivalent. 1 unit. *Chaiken*

Related courses in other departments include—*Business Administration:* Theory of Firm, Organization Theory, Information Systems, The Firm in Society; *Political Science:* Public Administration; *Social Science:* Social Stratification, Industrial Sociology.

Statistics and Operations Research

For. 250. Biometry. Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. *Yandle*

For. 251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 units. *Yandle*

For. 253. Computer Science in Natural Resources. Components and organization of a computer system; automatic programming languages; storage and retrieval systems (SAS); equation fitting by iteration and least-squares methods; graphical techniques. 3 units. *Rajagopal*

For. 258. Operations Research. Mathematical model formulation and development of techniques to aid decision-making in problems of natural resource allocation and use. Includes the theory and techniques of inventory control, equipment replacement planning, queuing theory, competitive strategies, allocation, sequencing, and dynamic programming. Consideration is given to both deterministic and nondeterministic models. 3 units. *Rajagopal*

For. 352. Theory and Applications of Linear Statistical Models. Theoretical development of the general linear statistical model, together with extensions to accommodate linear approximation of nonlinear cases. Curve-fitting techniques are developed, with emphasis on applications to natural phenomena. Prerequisite: consent of the instructor. 3 units. *Yandle*

For. 353. Design and Analysis of Experiments. Extension of the theory of estimation and testing for general linear models to include the less than full rank case. Experimental design models such as factorial and incomplete block models and developed as special cases of the general theory. Emphasis is placed on field and laboratory designs, together with appropriate computerized analysis techniques. Prerequisite: Forestry 352. 3 units. *Rajagopal*

For. 354. Quantitative Analysis of Ecological and Environmental Systems. (See description under Ecology above.)

Related courses in other departments include—*Mathematics:* Calculus, Numerical Analysis, Complex Analysis, Non-parametric, Statistics, Probability, Applied Mathematical Statistics, Stochastic Processes, Multivariate Statistics; *Economics:* Econometrics, Quantitative Analysis.

Special Studies and Research

For. 299. Special Studies in Forestry. Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

E.S. 299. Independent Projects in Environmental Studies. Work at the senior-graduate level to meet the needs of individual students in several areas of environmental studies. Credits and hours to be arranged. *Staff*

1. *Environmental Planning*
2. *Environmental Economics*
3. *Applied Ecology*
4. *Environmental Education*
5. *Environmental Communication and Media*
6. *Environmental Ethics and Values*
7. *Environmental Design*
8. *Environmental Policy*

For. 301, 302. Advanced Studies in Forestry. Work on the advanced graduate level to meet the needs of individual students is offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

E.S. 301, 302. Advanced Projects in Environmental Studies. Independent work at the advanced graduate level in areas designated under Environmental Studies 299. *Staff*

For.357, 358. Research in Forestry. Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged. *Staff*

1. *Forest Ecology.* Prerequisite: Environmental Studies 243 or equivalent. *Wuenscher*
2. *Forest Soils.* Prerequisite: Forestry 261 or equivalent. *Ralston*
3. *Silviculture.* Prerequisites: Environmental Studies 243 and Forestry 244 or equivalents. *White*
4. *Forest Management.* Prerequisite: Forestry 281 or equivalent. *Chaiken*
5. *Forest Economics.* Prerequisite: Forestry 270 or equivalent. *Convery*
6. *Wood Anatomy and Properties.* Prerequisites: Forestry 241 and 206 or equivalents. *Philpott*
7. *Forest Mensuration and Biometry.* Prerequisites: Forestry 250 and 352 or equivalents. *Yandle*
8. *Forest Entomology.* Prerequisite: Forestry 230 or equivalent. *Anderson*
9. *Forest Operations Research.* Prerequisite: consent of instructor. *Rajagopal*
10. *Dendrology.* Prerequisite: Forestry 241 or equivalent. *White*
11. *Forest-Tree Physiology.* Prerequisites: plant physiology and plant or forest ecology. *Barnes and Hellmers*
12. *Forest Pathology.* Prerequisites: plant physiology and Forestry 223 or equivalents. *Stambaugh*
13. *Forest Meteorology and Hydrology.* Prerequisites: Forestry 203, 342, or equivalents. *Knoerr*
14. *Forest Biochemistry.* Prerequisites: plant physiology and organic chemistry. *Barnes*
15. *Regional Land Use Planning.* Prerequisites: Environmental Studies 337 and 340. *Sullivan*
16. *Environmental Studies.* Prerequisites: consent of instructor. *Staff*

368. Field Seminars. Field studies, consultations, and visits to areas of interest during spring vacation period, or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. *Staff*

Numerical Listing of Courses

Forestry Courses

152. Conserving Natural Resources. 3 units
200. Careers in Natural Resources. No credit
203. General Meteorology. 3 units
204. Microclimatology. 3 units
205. Tree Growth and Development. 3 units
206. Anatomy of Woody Plants. 4 units
207. Chemistry of Woody Tissues. 3 units
208. Physiology of Wood Formation. 3 units
210. Forest Utilization. 2 units
215. Air Pollution Meteorology. 3 units
216. Watershed Hydrology. 3 units
217. Environmental Instrumentation. 4 units
222. Biology of Forest Insects and Diseases. 4 units
223. Forest Pathology. 4 units
225. Chemical Aspects of Forest Protection. 3 units
230. Forest Entomology. 3 units

233. General Entomology. 4 units
241. Dendrology. 3 units
244. Theory and Practice of Silviculture. 2 units; 3 units with laboratory
245. Management of Small Woodlands. 3 units
247. Forest Recreation and Landscape Management. 3 units
248. Forest Regeneration. 3 units
250. Biometry. 3 units
251. Theory and Methods for Sampling Biological Populations. 3 units
253. Computer Science in Natural Resources. 3 units
256. Forest Measurements. 4 units
258. Operations Research. 3 units
261. Soils and Forest Resources. 3 units
269. Resource Economics and Policy. 3 units
270. Economics of Forestry. 3 units
271. Financial Management. 3 units
272. Business Policy. 3 units
277. Seminar in Natural Resource Allocation and Efficiency. 1 unit
281. Forest Management. 3 units
283. Fire Behavior and Use. 2 units
289. Interpretation of Aerial Photographs. 2 units
292. Microtechnique of Woody Tissue. 3 units
299. Special Studies in Forestry. Credits to be arranged
301-302. Advanced Studies in Forestry. Credits to be arranged
304. Atmospheric Turbulence and Diffusion. 3 units
305. Forest Biochemistry. 3 units
306. Dynamics of Local Atmospheric Motion. 3 units
321. Phytopathological Technique in Forestry. 4 units
322. Microbiology of Forest Soils. 3 units
331. Toxicology of Insecticides. 3 units
332. Ecology of Forest Insects. 3 units; 4 units with laboratory
335. Entomological Research Techniques. 1 unit
342. Hydrologic Process. 3 units
344. Micrometeorology. 4 units
352. Theory and Applications of Linear Statistical Models. 3 units
353. Design and Analysis of Experiments. 3 units
354. Quantitative Analysis of Ecological and Environmental Systems. 3 units
357-358. Research in Forestry. Credits to be arranged
362. Forest Soil Physics. 3 units
364. Soil Classification and Mapping. 3 units
366. Forest Soil Fertility. 3 units
368. Field Seminars. Credits to be arranged
378. Seminar in Forest Economics. 2 units
382. Legal Aspects of Forestry. 1 unit
385. Seminar in Forest Protection. 1 unit
386. Seminar in Forest Management. 1 unit

Environmental Studies Courses

243. Natural Resource Ecology. 3 units
273. Economics and Environmental Quality. 3 units
299. Independent Projects in Environmental Studies. Credits to be arranged
301-302. Advanced Projects in Environmental Studies. Credits to be arranged
337. Ecological Analysis for Environmental Management. 3 units
340. Ecology and Land Use Planning. 3 units
341. Ecological Principles in Environmental Management. 3 units
346. Seminar in Environmental Policy. 1 unit
347-348. Natural Resource Ecology—Environmental Management Seminar. 1 unit

Appendix

ENROLLMENT

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John Edwin Fleming
Paul Bennett Geyer
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James Wallace Schlenker
Patrick Fred Shay
Harry Currier Stokes
Joseph Michael Vasievich
Donald Keith Whitenight
Steven Lamar Woodall

Master of Arts

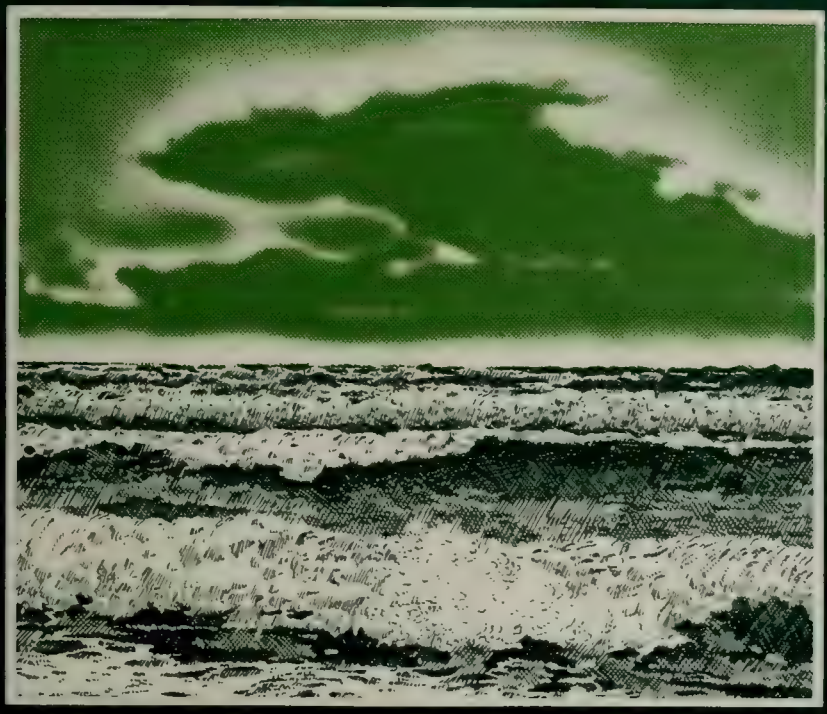
Sally Kirk Fairfax

Doctor of Philosophy

Nah-Doe Patrick Bropleh (B.Sc., University of Liberia; M.F., Oregon State University), Dissertation: "Rural Resources and Liberian Economic Development."
William Floyd Morgan II (B.S., University of Illinois; M.F., Duke University), Dissertation: "The Theory of the Firm and the Behavior of Woodland Owners: A Reappraisal Based on Empirical Evidence of Owners' Behavior."
Hans Georg Schabel (B.S.; M.S., University of Freiburg), Dissertation: "The Mode of Infection of *Hylobius pales* (Herbst) with *Metarrhizium anisopliae* (Metsch.) Sorok."



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Marine Laboratory



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General Information



The Laboratory

Through the efforts of Dr. A. S. Pearse, the Duke University Marine Laboratory was founded in 1938 on Pivers Island near the town of Beaufort, North Carolina. It was established initially to offer teacher training at the senior-graduate level, but research soon became an integral part of the program. Studies are currently being conducted in the fields of ecology, systematics, physiology, embryology, mycology, algology, and biological, chemical, geological, and physical oceanography. In addition to the graduate program, a newly established interdisciplinary program in the marine sciences now makes it possible for qualified undergraduates to spend the spring semester at the laboratory.

The Duke University Marine Laboratory presently occupies fifteen acres of the southern portion of Pivers Island; the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, Center for Menhaden Research encompasses the remainder of the island.

The physical plant consists of nineteen buildings including five dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, and six research buildings. The research laboratories and three dormitories are heated and air-conditioned thereby providing favorable conditions for year-round research.

Pivers Island is only 150 yards across the channel from the town of Beaufort. A bridge leads to U.S. Highway 70, so the Island is readily accessible by automobile. The only direct means of public transportation to Beaufort is by bus. The closest airport (served by Piedmont Airlines) is in New Bern, North Carolina, a distance of forty miles from Beaufort. Upon arrival at Beaufort, the laboratory may be reached by taxi.

The Beaufort area is well known for its moderate climate during the summer. Air temperatures range from an average minimum of 70 ° F. to an average maximum of 86 ° F. There is a prevailing southwest breeze from the ocean during most of the summer. Water temperatures range from 22-29 C. in June and from 24-30 ° C. during August.

Students should bring clothes suitable for field work including a sun hat, tennis shoes, bathing suit, shorts, work gloves, and sunglasses.

There are ample opportunities for recreation in and around Beaufort for swimming, fishing, boating, and water-skiing. On campus there are recreational facilities for swimming, diving, shuffleboard, horseshoe pitching, volleyball, croquet, and table tennis.



Resources for Study



Flora and Fauna

Beaufort is approximately midway between Woods Hole, Massachusetts, and Miami, Florida, in an area within the range of both the northern and southern species of biota. The edge of the Gulf Stream system is about 35 miles offshore, and between it and the shore occasional reefs are found.

The Beaufort area is strategically located for biological research because of the richness of its flora and fauna, and the ease with which one may reach many diverse habitats. From the laboratory, by boat or automobile, the ocean, Cape Lookout and the Outer Banks, Bogue and Core Sounds, Harker's Island, rivers, creeks, canals, mud flats, sand beaches, dunes, marshes, peat bogs, cypress swamps, bird islands and rookeries, and coastal forests are readily accessible. Long leaf pine, yaupon, and at least seven species of insectivorous plants (protected by law), including the Venus flytrap, grow in the region. A great variety of algae, both freshwater and marine, is also available for study. Common animals include the king crab, squid, shrimps, snails, clams, ctenophores, jellyfish, hydroids, sponges, polychaetes, sea urchins, starfish, brittle stars, sand dollars, skimmers, terns, gulls, herons, sea turtles, porpoises, and many different types of fish.

Research Interests

Much of the Marine Laboratory's early research consisted of determining distribution of plants and animals within the varying environments of the Beaufort estuary. With the addition of the Cooperative Oceanographic Program and the expansion of year-round activities, the general theme of the relationship of animals and plants to their environment has been broadened to include all segments of the estuarine and oceanic environments. Year-round research by resident staff, associates, visiting staff, and graduate students generally falls into five broad disciplines: biochemistry, developmental biology, oceanography, physiology, and systematics-ecology.

Biochemistry. The primary emphasis in the biochemical studies involves research on the structure, function, and evolution of protein molecules. Proteins, especially those involved in the transport of molecular oxygen (hemoglobin, hemocyanin, chlorocruorin, and hemerythrin), are being isolated and their structural and functional properties elucidated. These studies are in-

tended to illustrate how molecules have evolved and how they are involved in adaptive processes. From comparative studies one can illuminate structure-function relationships and derive data of phylogenetic significance. Studies of protein polymorphisms are also intended to illustrate gene flow among populations and offer insights into the adaptive strategies of marine organisms.

Developmental Biology. Much of the research in developmental biology deals with the culture of invertebrate larvae under controlled conditions in the laboratory, from hatching until the juvenile stages are reached. The availability of numerous larvae of known species, age, and stage of development has led to studies on the extent to which environmental factors within the marine environment affect rates of development, survival, and morphological abnormalities. In addition to studying the effects of natural environmental factors, research is under way to determine the effects of pollutants on larval development of marine crustacea. The developmental biology program also includes studies on the physiology of crustacean larvae and the factors involved in regulation of molting, rate of development, and metamorphosis during larval development.

Oceanography. Within the Oceanography Program, research is being conducted to examine the physical and biological dynamics of marine ecosystems which are enriched by upwelling, including the Coastal Upwelling Ecosystems Analysis Program, a multi-university and multi-ship field experiment concentration on the northwest African coast upwelling. Other interests include the effect of metal and dissolved organic interactions on the biological productivity of the upwelling system and the measurement and modeling of carbon productivity of the ecosystems. Research is also under way on the rate of recycling of sewage sludge and the impact of sewage disposal on marine systems, the chemical form and biological reactivity of toxic and essential metals as determined by electron paramagnetic resonance, the ability of phytoplankton to synthesize coordination compounds that form complexes with metals and alter their biological reactivity, and the isolation and identification of hydroxamic acids suspected of being responsible for the biogenic conditioning of sea water.

Geological investigations are primarily concerned with processes of continental margin sedimentation, largely within the Carolina continental shelf slope and rise, and also in certain deep basins in the vicinity of the Bahama Banks. Studies are concerned with the origin of postdeath shell coloration and the sediment distribution and sedimentary processes on the Cape Hatteras sediment plume, characterization of the continental rise and the relative importance of bottom currents versus gravity flows in forming the rise, and delineation of individual sorting effects. Additional research involves sea floor topography, including contouring and diagramming continental and insular margins with emphasis on the distribution and patterns of submarine canyons. Geomorphic studies are also under way in support of investigations in the Caribbean.

Physiology. In the realm of physiological studies, one primary interest involves studies on the photobiology of organisms in the marine environment, with emphasis on behavioral orientation to light. This involves determining the responses of a variety of marine organisms (unicellular dinoflagellates, larval crustaceans, and fish) to light, both in the natural environment as well as in the laboratory. Primary attention is on the identification of the light receptive pigments participating in the responses and the circadian rhythm of these re-

sponses. Accordingly phototaxis is used as a model system for studying the basic physiology of rhythms.

A second primary interest is in the mechanisms of ionic and osmotic regulation in marine plants and animals. This work involves a collaboration between the Department of Physiology and Pharmacology of Duke University and the Biochemistry Department of the University of Liege, Belgium. Euryhaline organisms can survive drastic fluctuations in salinity, and the internal adjustments made by these organisms may involve large changes in concentrations of amino acids and inorganic ions. One of our primary goals is to elucidate the metabolic processes which are responsible for these regulatory changes. Some marine organisms possess giant cells which offer unique opportunities for studying membrane transport processes. By internally perfusing these cells by means of micropipets we can control the internal ionic composition, hydrostatic pressure, and transmembrane voltage and current. At the same time we can measure the rates of solute and water movements across the cell surface, thus gaining insight into the mechanisms and functions of the transport processes.

Systematics-Ecology. Research in the Systematics-Ecology Program involves studies on community structure, benthic algae, and distribution of certain marine species off the North Carolina coast, and experimental phycology and phytoplankton systematics.

The major objective of studies on community structure is to identify and understand the processes which result in the temporal and spatial patterns in species abundance in some subtidal, epibenthic communities. Changes in the adult populations are followed with mapping and photographic techniques. The approach is experimental to the extent that species can be removed or excluded from the community to assess their importance in community structure and function. An eventual goal is the development of a systems model incorporating the basic community processes to provide the basis for predicting the deliberate or accidental effects of man's perturbations of these communities.

In part because the middle Atlantic coast is a meeting ground for the cool water species typical of northern shores and the warm water species of the Caribbean, studies include the determination of the distribution, phenology, and systematics of benthic algae off the coast of North Carolina. This work includes efforts to determine community structure and productivity in the different portions of Onslow Bay and to extend the studies north and south along the entire coast. A second aspect of the work is a descriptive study of the epiphytic algae which grow in the sounds on the blades of eelgrass and other marine angiosperms.

In experimental phycology and phytoplankton systematics, the program of research comprises several related major areas particularly concerned with the biology of the algal class Haptophyceae (coccolithophorids and others). Experimentally oriented systematics investigations of marine phytoplankton are concerned primarily with life cycles and morphological variation. Ultrastructural and physiological research emphasizes the intracellular deposition of calcium carbonate into coccoliths—their formation, regulation, and relationships to other cellular processes. Another line of physiological and biological oceanographic research is concerned with growth and calcification of phytoplankton in very dim light and darkness in an attempt to elucidate naturally occurring deep-sea populations.

Additional studies are being conducted to investigate the growth rates and development of suspension feeders in relation to temperature, size of the animals, concentration of suspended material, and the relative concentration

of phytoplankton in suspension. These experiments involve natural seawater in a continuous flow system in which the concentration of phytoplankton can be monitored. The data should determine the conditions under which maximum energy transfer occurs between primary producers and a primary consumer, facilitating the future exploitation of scallops, oysters, and other similar species.

Research Facilities

Laboratory Equipment and Supplies. Visiting investigators may obtain research space throughout the year. Each research laboratory building is air-conditioned and equipped with running seawater through a hard rubber system. There are tanks, water tables, aquaria, autoclaves, ovens, and plant presses. In addition to commonly used laboratory equipment, the following are available: two refrigerated centrifuges with multi-speed attachments, Beckman DU spectrophotometer, balances, pH meters, hoods, and constant temperature equipment. Each person is expected to supply his own optical equipment or other special apparatus needed. A list of equipment, chemicals, and glassware may be obtained upon request. The laboratory also maintains a darkroom and well-equipped workshop.

New Research Facility. A three-story modern research laboratory was completed in early summer 1972. Each room is well lighted artificially and all exterior rooms also receive natural light. Most rooms have a view of the water surrounding some part of Pivers Island. All rooms are air-conditioned and heated electrically so that the temperature of each room can be controlled to suit the needs of the occupant. Hot and cold water, air, gas, and vacuum are available in most rooms. The non-metallic seawater system is especially designed to reduce silt and fouling. The general arrangement of rooms on each floor provides for a core of rooms in the center of the building which are for general use and research rooms of different sizes are at the periphery of the building. Although the rooms on all three floors were designed for special purposes, they may be used for research in a variety of disciplines.

Oceanographic Study. The 117.5-foot research vessel *Eastward* with a capacity for forty students on eight-hour cruises or fourteen students and staff on extended cruises may be used for oceanographic research. During the present year, the ship will operate in the Atlantic Ocean from the coast to the mid-Atlantic Ridge and south to Venezuela. It is outfitted with modern recording and collecting devices and is available to investigators and teachers of graduate courses in marine sciences and their students. Application for ship time must be made in advance. Inquiries should be addressed to the Oceanographic Program Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Collecting. Spades, shovels, sieves, and nets are provided without charge to assist the investigator with his collecting. A wide assortment of boats is available for various collecting activities. A complete schedule of boats and charges may be found in the section on Financial Information. Information on species availability and collecting sites is available from the Curator of the Reference Collection.

I. E. Gray Library-Auditorium. This facility is air-conditioned, electrically heated, and has stack space for 18,500 volumes on the first floor. A sec-

ond floor is intended for future expansion. Located in the building are the librarian's office, a room for duplicating machines, a receiving room, a kitchenette, two seminar rooms, and two closed carrels.

The building houses the Pearse Memorial Library which contains 4,250 catalogued reference books and journals, 150 current journals, and 1,720 reprints. There are also expedition reports in oceanography, a microfilm library of graduate student theses based on research at the laboratory, a microfilm reader, and an A. B. Dick copier. Other materials may be obtained by a special delivery system from the Perkins Library on the Durham Campus or through the interlibrary loan service with other libraries in the United States.

The auditorium has a seating capacity of approximately 300 and is suitable for lectures, seminars, symposia, and small regional or national meetings.

Reference Collections. A reference collection of approximately 1,500 different species of animals from coastal North Carolina is available to students and research personnel. Small collections of marine algae and vascular flora are also maintained, as well as a checklist by habitat of the common marine animals.

Computing Facilities. A PDP 11/20 digital computer is available for general student and staff use. It has an 8-K core memory bank and uses BASIC, a conventional, on-line language similar to FORTRAN. The input-output device is an ASR-33 teletype.

Electron Microscope. The electron microscope laboratory comprises a microscope room housing an RCA EMU-3F transmission electron microscope, a photographic darkroom, a sectioning room housing a Porter Blum MT2-B ultramicrotome and light microscopes, and a preparation room with fume hood, vacuum evaporator, etc. The facility is available to qualified users; however, requests for microscope time must be made in advance. Address inquiries to: Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.





Financial Information



Tuition

Summer Terms. The following are tuition charges for summer registration and medical care:

1. Undergraduate students: $231 for each nonlaboratory course; $308 for each undergraduate laboratory course; and $462 for each one and one-half course (6 unit) program offered at the Duke University Marine Laboratory.
2. Graduate students: $77 per unit; and for an undergraduate course, the tuition rate indicated in section 1 above is applicable.
3. Full-time teachers in elementary and secondary schools: one-half of the tuition charge specified in sections 1 and 2 above is applicable.

The Director of the Summer Session will notify the applicant of course approval. Tuition should then be paid promptly to the Director of Summer Session, Duke University, Durham, North Carolina 27706, to assure reservation in a course.

Spring Term. Tuition, at the rates indicated in the *Bulletin of Undergraduate Instruction*, will be paid at Duke University not later than the day of registration for the term.

Tuition must be received at least one week before the beginning of the term. Students who have not completed registration by 4:00 p.m. of the final day of registration of each term will be subject to a late registration fee.

Refunds

In the event of death or involuntary withdrawal to enter the armed services, refunds will be made on a pro rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before the beginning of classes: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, and fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.



Research Space

Individual research cubicles varying from 80 to 400 square feet are available at the Duke University Marine Laboratory. The rental fee for research space is $1 per square foot per month from May 1, 1975, to April 30, 1976.

No additional charges are made for research assistants occupying the same research space as the investigators. Graduate students from institutions other than Duke University will be charged one-half the regular rate per person. Laboratory space rental does not apply to students participating in the Spring Undergraduate Program.

Inquiries and requests for space should be addressed to Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. Applications for the academic year are encouraged and will be acted upon shortly after they are received. All research applications for the summer of 1975 must be received by March 10, 1975.

Living Accommodations

Dormitories. Air-conditioned and a few non-air-conditioned dormitory rooms are available. Although every effort is made to have only two people per dormitory room, a few triple rooms may be needed to accommodate all individuals requiring dormitory space. Prospective students should indicate their preference for housing on the application for enrollment. It is impossible to guarantee that these preferences will be available in all cases.

Occupants must supply their own linens, blankets, and towels, but pillows will be furnished. All dormitory occupants will be on the board system during the spring semester and summer terms. A key deposit of $1 will be charged each person occupying a dormitory room. This deposit will be refunded at time of departure.

Dormitory charges which are payable at the Business Office of the laboratory upon arrival are as follows:

Summer 1975

Non-air-conditioned double	$62.00 per term for each occupant
Air-conditioned double	$68.00 and $78.00 per term for each occupant
Air-conditioned triple	$57.00 per term for each occupant

Spring 1976

Non-air-conditioned double	$195.00 per semester for each occupant
Air-conditioned double	$204.00 and $234.00 per semester for each occupant

Double rooms for married students are usually supplied only if both husband and wife are registered students at the Laboratory.

Beaufort Housing. Because Beaufort is located in a resort area, off-campus housing is very difficult to obtain and costs may range from $20 to $50 per week per person. Housing for married couples who are not both registered students at the laboratory and couples with children in the Morehead City-Beaufort area is limited. A list of area realtors will be mailed to students upon request.

Dining Facilities*

The Duke University Marine Laboratory dining hall will be open during spring semester and first, second, and third summer sessions. All dormitory residents are required to pay the full board fee of $145 per summer term. Students residing off-campus may purchase a full board meal ticket, weekly meal ticket, or individual meals. Individual meals are the most expensive, and full board is the least expensive on a meal-by-meal basis. Individual meal rates are as follows:

Breakfast	$1.15
Lunch	$1.65
Dinner	$2.20
Sunday dinner	$2.50

*All dining hall rates are subject to change without notice. Board fee for spring semester has not been determined.

Children under twelve will be charged one-half the adult rate.

The full board fee provides for three meals per day, Monday through Saturday, and breakfast and noon dinner on Sunday. No credit will be allowed for meals that are missed, including those meals which may be missed as a result of research cruises in conjunction with course work. Meals will usually be provided on these cruises.

Research personnel and their families residing off-campus are urged to eat in the dining hall. Arrangements may be made for occasional meals if sufficient notice is given at the Business Office of the laboratory.

The board fee is payable in full on or before the day of registration at the Business Office of the laboratory.

Boat Rentals

The following boats are available at the laboratory for collecting and instructional activities:

Boat Type	Name	Charges
55 ft. trawler	Beveridge*	$ 26.00 per hour $208.00 per day
39 ft. cabin Diesel powered	Venus*	$ 18.00 per hour $144.00 per day
17.5 ft. speedboat	Thunderbird	$ 14.00 per hour $112.00 per day
22.10 ft. open boat	Ocypode	$ 14.00 per hour $112.00 per day
Boston Whaler		$ 6.00 per hour $ 48.00 per day
Skiffs with outboard motors		$ 3.50 per hour $ 25.00 per day

*Crew required for safety of user and vessel.

These rates are intended to partially defray the cost of operating and maintaining these boats.

These boats may be scheduled by visiting researchers through the Maintenance Office; however, first priority must be given to classes when they are in session during the spring and summer terms.

If crew overtime is involved before or after their normal work day and any time Saturday or Sunday, the following charges will be made from July 1, 1975, to June 30, 1976: Master, $5.85 per hour; Winch Operator, $5.00 per hour; additional charge for overtime on Duke University holidays, $3.00 per hour.

Other Financial Information

Check Cashing. The banks in the Morehead City-Beaufort area have indicated that they will not cash personal checks for students unless they are guaranteed. Therefore, it is recommended that students at the laboratory bring with them sufficient traveler's checks, money orders, certified checks, or cash to cover expenses.

Other Fees. Late registration fees will be charged in accordance with Duke University policy unless registration is completed and all fees paid by the last day of registration for the term.

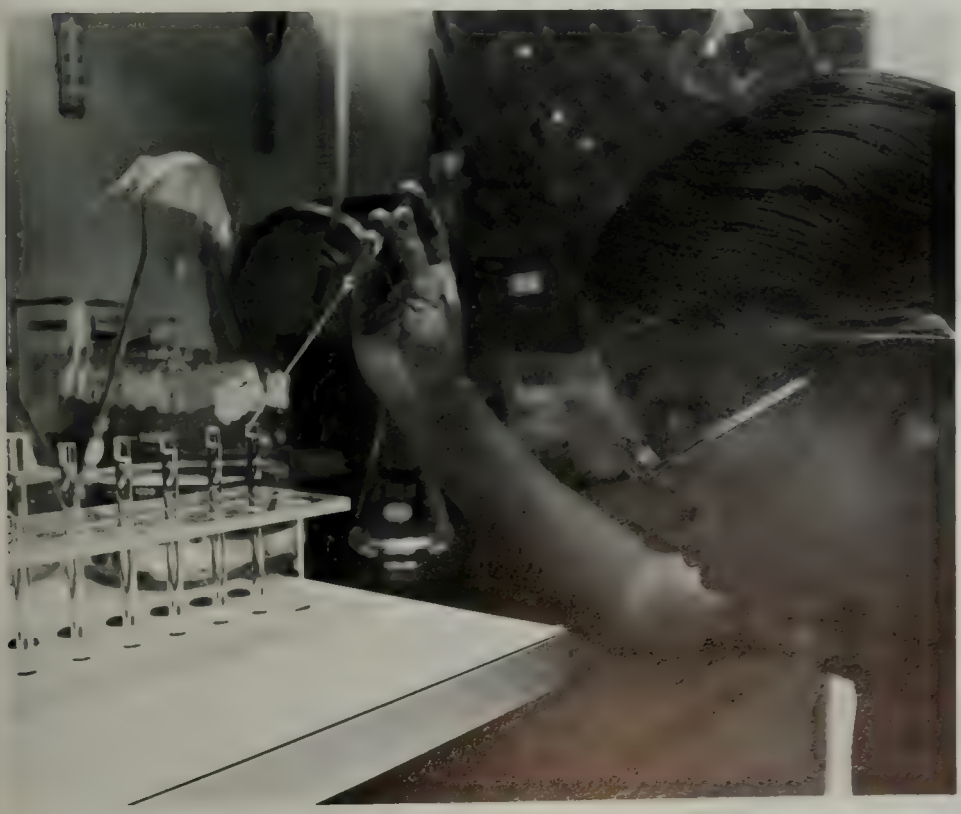
Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Teaching Assistantships

Five graduate student teaching assistantships are available during the period from January 1 through August 31 of each year. Students registered in a graduate program in any department in the sciences at Duke University may apply. Recipients must be in residence at Beaufort during the period of their appointment and also conduct, or plan to conduct, their research at the Duke University Marine Laboratory in Beaufort.

Applications must be received by the Director of Graduate Student Affairs before October 1. Applicants will be judged on the basis of need, qualifications for the courses in which they will assist, and previous teaching and graduate experience. A student may receive a maximum of three years' support under this program.

For further information, write to the Director of Graduate Student Affairs, Duke University Marine Laboratory, Beaufort, North Carolina 28516.





Admission



Requirements and Procedures

All students applying to the Duke Marine Laboratory should complete the appropriate application form at the back of this *Bulletin* and submit a transcript of their grades. Applicants will be considered without regard to race, color, religion, sex, or national origin. Students desiring a transfer of credit to their home institutions should request a course approval form for transfer of credit from the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Summer Terms. All courses offered at the laboratory during the summer are intended for graduate students and senior undergraduate students. Applications should be submitted to the Director of the Duke University Marine Laboratory as early as possible and not later than March 10. Late applicants will be admitted if space permits. After acceptance, payment of tuition is essential to assure reservation in a course.

Students wishing to apply summer credits toward an advanced degree at Duke University must, in addition to filling in the application blank, register with the Duke University Graduate School. Students who have had adequate preparation and approval of their major professor may request space for independent or thesis research.

Students should plan to arrive on Sunday, May 11 (Term I); Sunday, June 15 (Term II); or Sunday, July 20 (Term III); at which times dormitory rooms will be ready for occupancy. Final registration will begin for all students at 8:00 a.m., May 12; 8:00 a.m., June 16; and 8:00 a.m., July 21.

Spring Semester. An interdisciplinary program in the marine sciences is offered at the Duke Marine Laboratory for the spring semester. The program is open to qualified juniors and seniors from Duke and other colleges and universities. The full semester program for each student consists of two courses, one or two seminars, and independent study. Applications are to be submitted by October 7 to the Director of the Duke University Marine Laboratory. Each applicant should request two letters of recommendation, one of which must be from the director of undergraduate studies, or the equivalent, from the student's major department. Students will be notified of the action of the Admission Committee prior to registration for the spring semester. (The application form is in the back of this *Bulletin*.)



Courses of Instruction



FIRST SUMMER TERM

May 12-June 13, 1975

Introduction to Biological Oceanography. (Zoology 114L.) Physical, chemical, and biological processes that characterize the oceans, emphasizing special adaptations of organisms for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: college biology. One and one-half courses (6 graduate units). *Cox*

SECOND SUMMER TERM

June 16-July 18, 1975

Independent Study. (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Marine Ecology. (Zoology 203). Ecological processes as exemplified by marine organisms. Lectures will cover environmental factors, intra- and interspecific relationships, and community ecology. Class discussions on selected papers. Field projects utilizing current ecological methods. Practice in scientific writing. Use of computers in ecology. Prerequisites: a course in general zoology, invertebrate zoology, or an appropriate equivalent, and a year of mathematics; some knowledge of statistics will be helpful. One and one-half courses (6 graduate units). *Sutherland*

Comparative and Evolutionary Biochemistry. (Biochemistry 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, finger-printing, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). *Sullivan*



Invertebrate Embryology. (Zoology 278.) Lectures, readings, and laboratory work dealing with rearing, development, and life history of invertebrates. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). *Bookhout*

Phytoplankton Systematics. (Botany 202.) Introduction to taxonomy and the classification of marine phytoplankton: their general characteristics, phytogeography, life histories, and techniques for preservation, preparation, and enumeration of phytoplankton samples. Individually arranged advanced work in selected areas. One and one-half courses (6 graduate units). *Blankley*

Physiological Ecology of Marine Animals. (Zoology 250.) A study of the physiology of marine and estuarine animals in relation to certain environmental factors (temperature, salinity, oxygen, and light). Animals representing numerous phyla from various habitats are studied. Prerequisite: a course in physiology and general zoology. One and one-half courses (6 graduate units). *Forward*

Chemical Oceanography. (Chemistry 240.) Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 161, 162, or equivalent); statistics (Mathematics 183, or equivalent), or permission of the instructor. Lectures, laboratory work, and field trips. One and one-half courses (6 graduate units.) *Baier*

Geological Oceanography. (Geology 205.) The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (The course is not open to students who have completed Geology 206.) One and one-half courses (6 graduate units). *Pilkey*

Research. (Zoology 354.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) *Staff*

THIRD SUMMER TERM

July 21-August 22, 1975

Independent Study. (Botany, Geology, or Zoology 191T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Introduction to Comparative Behavior. (Zoology 202.) Analysis of behavior, as revealed by physiological, evolutionary, and ecological study. Primary (but not exclusive) emphasis is placed upon marine groups. Lectures and laboratories. Prerequisite: one course in physiology. One and one-half courses (6 graduate units). *Salmon*

Membrane Physiology and Osmoregulation. (Physiology 212.) Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course also includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in plants and animals. Laboratory work deals with membrane transport processes in single cells and epithelia, electrophysiology and synaptic transmission in mollusks, renal and gill transport processes in fish, amino acid transport and metabolism in crustaceans, and the application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). *Gutknecht, Kirschner, Evans, and Staff*

Marine Invertebrate Zoology. (Zoology 274.) A study of invertebrate

animals that occur in the Beaufort region. A number of field trips will be made to a variety of habitats to study and to collect animals in their natural environment. The structure and habits of living invertebrates, as well as their behavior under experimental conditions, will be studied in the laboratory. (Zoology 274 is not intended for students who have had a graduate course in invertebrate zoology.) Prerequisite: a course in general zoology or general biology. One and one-half courses (6 graduate units). *Dimock*

Biological Oceanography. (Zoology 214.) The special adaptations of organisms for life in the sea and the impact of biological processes on the nonliving components of the marine environment provide the core of the biological oceanography course. Among the ideas emphasized are the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in regulating the abundance, distribution, and community organization of marine organisms. A cruise on the R/V *Eastward* will investigate the physical and chemical processes which support the biological productivity of the continental shelf ecosystem. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). *Barber*

Chemical Pollution of Coastal Waters. (Chemistry 230.) Sources and sinks for chemical pollutants and impact on coastal biomes. Laboratory and field experiments to illustrate problems in verifying the extent of chemical pollution. Analysis of exemplary chemical plants to derive plans for pollution control. Prerequisites: Chemistry 161 and 162, or equivalent; Chemistry 132, or equivalent; and calculus or permission of instructor. One and one-half courses (6 graduate units). *Baier*

Marine Microbiology. (Botany 204.) The major groups of marine microorganisms: bacteria, fungi, protozoa, and phytoplankton—their taxonomy, culture, physiology, and ecology. Field and laboratory work with observational and experimental methods on the dynamics of marine microorganisms. Prerequisite: a course in general biological science or botany. One and one-half courses (6 graduate units). *Cavaliere*

Marine Phycology. (Botany 211.) An introduction to marine algae—their identification, taxonomy, morphology, physiology, and ecology. Field trips are complemented by laboratory study, culturing, and preparation of herbarium material. One and one-half courses (6 graduate units). *Searles*

Research. (Zoology 353.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory is required. (For graduate students only.) *Staff*

Spring Semester—Undergraduate Program

The semester program consists of the courses listed below. A student may apply during the spring to continue study at the Marine Laboratory during the summer either by participating in senior-graduate courses or by continuing the independent studies initiated during the spring term.

Man and the Marine Environment. (Interdisciplinary Course 104.) Economic, legal, medical, political, social, and scientific viewpoints on the extent to which modern society has affected the marine environment, with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Prerequisite: consent of instructor and director of undergraduate studies of student's major department. One course. *Costlow and Staff*



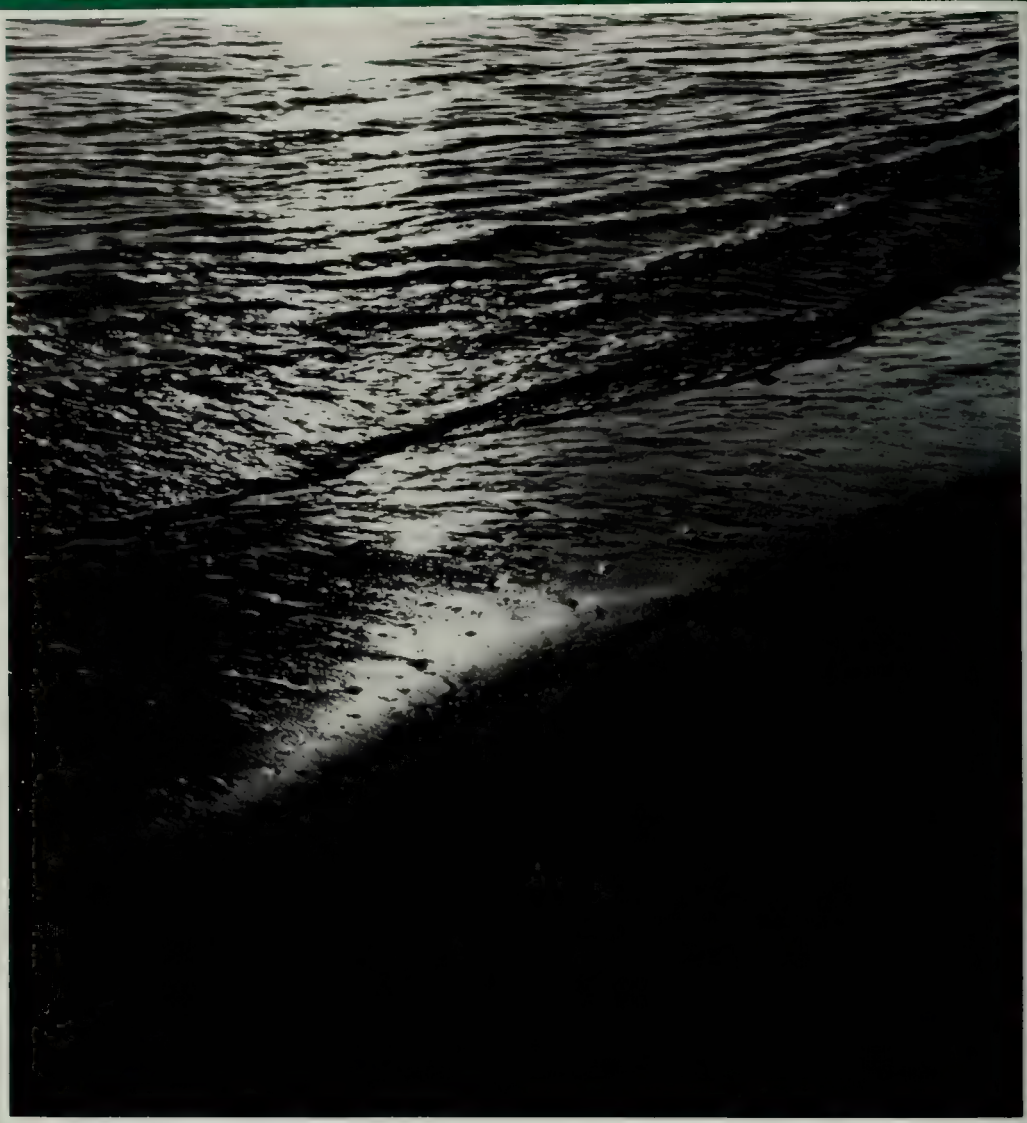
Adaptations of Organisms to the Marine Environment. (Biochemistry 220.) An introduction to basic concepts of biochemistry and to variables in the marine environment which evoke adaptive responses. Specific adaptations at the molecular level are considered and the general topic of biological fitness is discussed from a biochemical viewpoint. Laboratory experiments utilize many basic methods of biochemical analysis. The course is designed to stimulate interest in the molecular basis of adaptation and to give participants greater insight into the unsolved problems in this area. Prerequisites: basic biology and chemistry and consent of instructors. One course. *C. Bonaventura and J. Bonaventura*

The Marine Environment. (Botany, Geology, or Zoology 169.) The interrelationships of the geological, chemical, and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisite: introductory chemistry and consent of instructor and the appropriate director of undergraduate studies. One course. *Sutherland*

Physiology of Marine Organisms. (Zoology 150L.) Comparative physiology of marine animals including special ecological and behavioral adaptations. Lectures and laboratories. A student may not not receive credit for both Zoology 150L and 250L. Prerequisite: introductory biology and chemistry; consent of instructor and director of undergraduate studies of student's major department. One course. *Forward*

Seminar. (Biochemistry 296S.) Recent research in the biochemistry and genetics of marine organisms: enzymes, evolution and ecological strategies. Half-course. *Sullivan.* (Botany 225S.) Current topics in coastal and marine botany. Half-course. *Blankley.* (Zoology 296S.) Man's impact on biogeochemical cycles. Half-course. *Barber and Baier*

Independent Study. (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the director of undergraduate studies and the supervising instructor. One and one-half courses. *Staff*



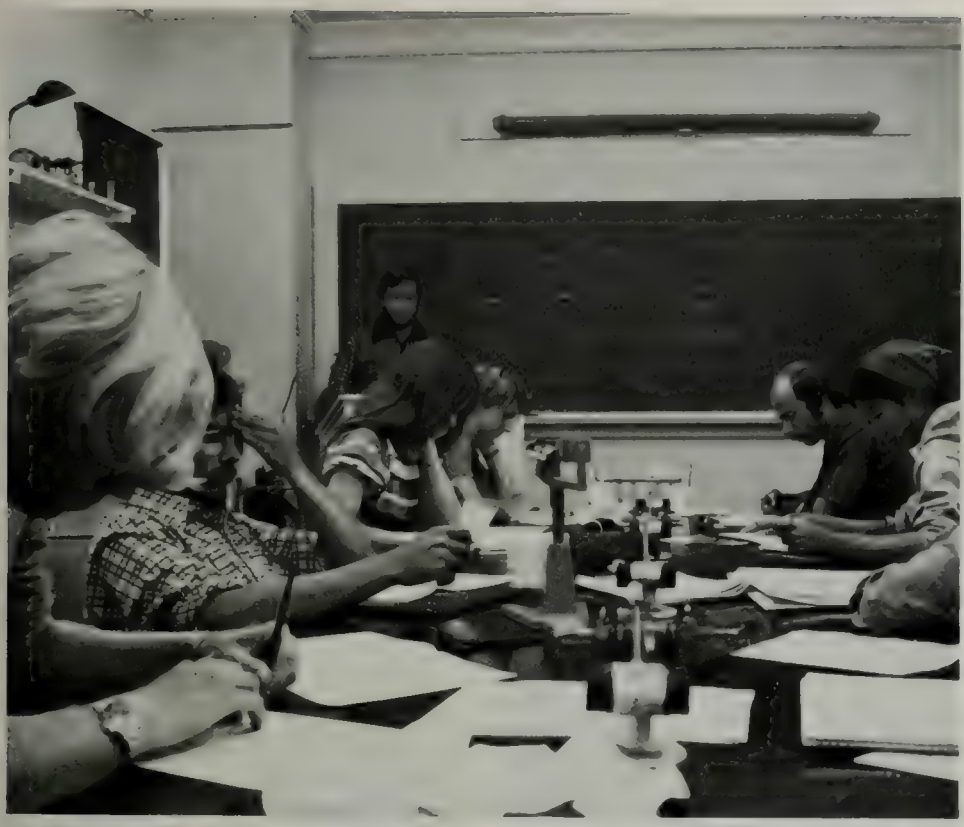
Seminars



Academic Year 1973-1974

Date	Speaker	Topic
Oct. 19	Dr. N. dePauw University of Ghent Ghent, Belgium	A comparison of brackish water phytoplankton assemblages in the southern part of the Netherlands
Oct. 19	Dr. P. DeWolf Institute of Oceanography Texel, The Netherlands	Dispersal of barnacle larvae in the western Wadden Sea
Dec. 4	Dr. Patricio Sanchez Laboratorio Zoologia Instituto de Ciencias Biologicas Universidad Catolica de Chile Casilla 114-D, Santiago, Chile	Water movements over the surfaces of asteroids
Jan. 21	Mr. Milton Heath Institute of Government University of North Carolina Chapel Hill, North Carolina	North Carolina coastal area management program
Feb. 4	Mr. W. Kaufman Department of English University of North Carolina Chapel Hill, North Carolina	Citizen action: local vs. state interests
Feb. 7	Dr. Bodil Schmidt-Nielsen Mount Desert Island Biological Laboratory Salisbury, Maine	Water and solute transport in the mammalian kidney
Feb. 15	Dr. C. L. Weekman Department of Entomology North Carolina State University Raleigh, North Carolina	The "otherside" of pesticides in the marine environment

March 5	Dr. James L. Cox Department of Biology Southeastern Massachusetts University North Dartmouth, Massachusetts	Biological aspects of cyclonic rings in the Sargasso Sea
March 19	Dr. E. L. Bousfield Chief Zoologist National Museum of Natural Sciences Ottawa, Canada	Population dynamics of zooplankton of the Middle St. Lawrence Estuary
March 20	Dr. R. B. Holliman Department of Biology Virginia Polytechnic Institute and State University Blacksburg, Virginia 24061	Dysentery, dehydration, and death
March 27	Dr. Paul Godfrey Department of Botany University of Massachusetts Amherst, Massachusetts	Maintenance of the Outer Banks
April 3	Dr. Gilbert T. Rowe Woods Hole Oceanographic Institute Woods Hole, Massachusetts	Nutrient regeneration from near-shore sediments: conceptual models, simulation, and experiments
April 18	Dr. Austin Williams Systematics Laboratory National Marine Fisheries Service U. S. National Museum Washington, D. C.	Swimming crabs of the genus *Callinectes*
April 22	Dean Ralph Fadum School of Engineering North Carolina State University Raleigh, North Carolina	Ground water problems in eastern North Carolina
April 23	Dr. Ernest Naylor Department of Marine Biology University of Liverpool Port Erin Isle of Man, U. K.	Emergence rhythms in burrowing crustaceans
April 25	Dr. B. F. Phillips Division of Fisheries and Oceanography CSIRO 102 Flora Terrace North Beach, Western Australia 6020	Current research into the western rock lobster



April 29	Dr. Bruce Menges Department of Biology University of Massachusetts Boston, Massachusetts	Ecological studies on the rocky intertidal of the northeastern United States
May 13	Dr. W. D. Russell-Hunter Department of Biology Syracuse University Syracuse, New York	Aspects of sex changes in molluscs in relation to future farming
May 15	Dr. Dirk Frankenberg Department of Zoology University of Georgia Athens, Georgia	Georgia coastal marshes
May 20	Dr. Ruth Turner Museum of Comparative Zoology Harvard University Cambridge, Massachusetts 02138	Problems of thermal effluents in estuaries and biology of marine borers
May 21	Dr. Bruce Coull Department of Zoology University of South Carolina Columbia, South Carolina	Community studies on on subtidal meiobenthos









May 22	Dr. Richard Barber Duke University Marine Laboratory Beaufort, North Carolina	Phytoplankton growth in upwelling ecosystems
May 23	Dr. Jan Kolhmeyer University of North Carolina Institute of Marine Science Morehead City, North Carolina	Role of fungi in the marine environment

May 28	Dr. Oswald Roels Lamont Doherty Geological Observatory Columbia University Palisades, New York 10964	Artificial upwelling
May 30	Dr. James Cox Department of Biology Southeastern Massachusetts University North Dartmouth, Massachusetts	Sargassum production in the west Sargasso Sea
June 4	Dr. C. G. Bookhout Duke University Marine Laboratory Beaufort, North Carolina	Effects of fire ant control measures on crabs and their larvae
June 6	Dr. Ken Mitchell Department of Zoology The University Glasgow G12 8QQ Great Britain	Communal living among hermits
June 11	Dr. G. T. Barthalmus Department of Zoology North Carolina State University Raleigh, North Carolina	The effect of sublethal levels of mercury on behavior of the sand shrimp
June 13	Dr. Jessica Lewis Department of Medicine University of Pittsburgh Pittsburgh, Pennsylvania	Hemostatic mechanisms in marine animals compared to those in man
June 18	Dr. Bertil Akesson Department of Zoology University of Gothenburg Fack, S-400 33 Gothenburg 33 Sweden	Reproductive patterns and speciation in the genus *Ophryotrocha*
June 20	Dr. Rutger Rosenberg Swedish Water and Air Pollution Research Laboratory P. O. Box 5207 S-402 24 Gothenburg Sweden	Effects on marine organisms of chlorinated hydrocarbons formed as residues in plastic production
June 25	Mr. Gary Hyatt Department of Biological Sciences University of Illinois at Chicago Circle Chicago, Illinois	Physiological and behavioral studies of color vision in fiddler crabs (Brachyura, Ocypodidae, genus *Uca*)

June 27	Dr. Rudolf Scheltema Woods Hole Oceanographic Institution Woods Hole, Massachusetts	Larval dispersal and rafting of marine invertebrates: paleobiographical and biostratigraphical implications
July 2	Dr. John Lucas School of Biological Sciences James Cook University of North Queensland QLD. 4811 Australia	Environmental influences on development of the "crown of thorns," *Acanthaster*
July 4	Dr. Michael Salmon Department of Zoology University of Illinois Urbana, Illinois	Courtship in fiddler crabs
July 9	Dr. Brigitte Volkmann Istituto di Biologia del Mare Riva 7 Martiri, 1364/A 30122 Venezia, Italy	Systematics and speciation in the genus *Tisbe* (Copepoda, Harpacticoida)



July 11	Dr. T. Wolcott Department of Zoology North Carolina State University Raleigh, North Carolina	Limits and limpets: a tale of physical factors and biotic zonation in the rocky intertidal
July 16	Dr. William W. Kirby-Smith Duke University Marine Laboratory Beaufort, North Carolina	Biological aspects of suspension feeding aquaculture systems
July 18	Dr. Mirjana Brenko Rudjer Boskovic Institute Center for Marine Research Rovinj Laboratories Rovinj, Yugoslavia	Investigations on the biology of *Mytilus sp.*
July 23	Dr. John Sutherland Duke University Marine Laboratory Beaufort, North Carolina	Experimental studies on the fouling community at Beaufort, North Carolina
July 25	Dr. Michael Levandowsky Haskins Laboratory at Pace College 41 Park Row New York, New York	Problems of chelation in the marine environment
July 30	Dr. Rodger Baier Duke University Marine Laboratory Beaufort, North Carolina	Lead transport in the Fear River estuary
August 1	Dr. Orrin Pilkey Department of Geology Duke University Durham, North Carolina	Turbidity current sedimentation on the Hispaniola Caicos Abyssal Plain
August 6	Dr. William F. Blankley Duke University Marine Laboratory Beaufort, North Carolina	Aphotic phytoplankton
August 8	Dr. Ronald Dimock Department of Biology Wake Forest University Winston-Salem, North Carolina	Behavioral ecology of a symbiotic polychaete
August 13	Dr. Richard Forward Duke University Marine Laboratory Beaufort, North Carolina	The photobiology of the larvae of the mud crab, *Rhithropanopeus*
August 14	Dr. William Odum University of Virginia Charlottesville, Virginia	Assimilation of carbon and trace metals in the estuaries



Publications



1973-1974

Amerson, H. V. and C. E. Bland. 1973. The occurrence of polycomplexes in the nucleus of encysting spores of *Lagenidium callinectes*, a marine phycomycete. *Mycologia*. (In Press.)

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——— and J. D. Costlow, Jr. 1974. Crab development and effects of pollutants. *Thalassia Yugosl.* (In Press.)
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Appendix

CALENDAR FOR SUMMER SESSION, 1975

Term I begins—May 12
Term I ends—June 13

Term II begins—June 16
Term II ends—July 18

Term III begins—July 21
Term III ends—August 22

ADMINISTRATION AND LABORATORY PERSONNEL

Advisory Committee

John D. Costlow, Ph.D., Director
Duke University Marine Laboratory

Donald J. Fluke, Ph.D., Chairman
Department of Zoology

John W. Gutknecht, Ph.D.
Department of Physiology and Pharmacology

R. L. Hill, Ph.D., Chairman
Department of Biochemistry

Sigfred L. Linderoth, Jr., M.S.
Department of Mechanical Engineering

Orrin H. Pilkey, Ph.D.
Department of Geology

Louis Quin, Ph.D., Chairman
Department of Chemistry

Richard B. Searles, Ph.D.
Department of Botany

Academic Staff

Rodger Baier, Ph.D.
Chemical oceanography

Richard T. Barber, Ph.D.
Biological oceanography

William F. Blankley, Ph.D.
Phytoplankton systematics and experimental phycology

Joseph Bonaventura, Ph.D.
Protein structure and function

C. G. Bookhout, Ph.D.
Marine invertebrate embryology and invertebrate zoology

*Ralph Cavaliere, Ph.D.
Marine microbiology

John D. Costlow, Ph.D.
Marine invertebrate embryology and experimental zoology

*James Cox, Ph.D.
Biological oceanography

*Ronald Dimock, Ph.D.
Marine invertebrate zoology

Richard B. Forward, Ph.D.
Physiological ecology of marine animals

I. E. Gray, Ph.D., Professor Emeritus
Marine ecology and entomology

John Gutknecht, Ph.D.
Membrane physiology

William Kirby-Smith, Ph.D.
Marine Ecology

*Orrin Pilkey, Ph.D.
Geological oceanography

*Michael Salmon, Ph.D.
Behavior of marine animals

*Richard B. Searles, Ph.D.
Marine phycology

J. Bolling Sullivan, Ph.D.
Comparative and evolutionary biochemistry

John Sutherland, Ph.D.
Marine ecology

*Summer only.

Administrative Staff

Director of Cooperative Program in Biological Oceanography
Coordinator, Coastal Upwelling Ecosystems Analysis
Richard T. Barber
Associate Professor of Zoology and Botany

Director
John D. Costlow
Professor of Zoology

Director of Graduate Student Affairs
John P. Sutherland
Assistant Professor of Zoology

Director of Graduate Student Affairs
John P. Sutherland
Assistant Professor of Zoology

Director of Undergraduate Student Affairs
Rodger W. Baier
Assistant Professor of Chemistry

Business Manager
Craig Horne

Maintenance Supervisor
Norris Hill

Marine Superintendent of Oceanographic Operations
John G. Newton

Assistant Marine Superintendent of Oceanographic Operations
Eric B. Nelson

Master of R/V EASTWARD
Ragnvald Sandoy

Information Specialist of Coastal Upwelling Ecosystems Analysis
Robert H. Warsing



Research

Bertil Akesson, Ph.D.
Department of Zoology
University of Gothenburg
Fack, S-400 33 Gothenburg 33
Sweden
Visiting Professor
The effect of cyclic temperature on the life cycle of *Dinophilus gyrociliatus* (Archiannelida); Speciation in the polychaete genus *Ophryotrocha*; and the life cycle of a thigmotrich ciliate, commensal on *Ophryotrocha labronica*.

Rodger Baier, Ph.D.
Duke University Marine Laboratory
Staff
Trace metal studies in coastal waters.

Richard T. Barber, Ph.D.
Duke University Marine Laboratory
Staff
Coastal upwelling ecosystems analysis; Biogeochemical cycling of organic matter and metals; and Phytoplankton nutrition and organometallic complexes in the sea.

William F. Blankley, Ph.D.
Duke University Marine Laboratory
Staff
Experimental phycology: systematics, ultrastructure, and physiology of marine phytoplankton.

Celia Bonaventura, Ph.D.
Duke University Marine Laboratory
Research Associate
Photochemical reactions of protein molecules.

Joseph Bonaventura, Ph.D.
Duke University Marine Laboratory
Associate, Department of Biochemistry
Duke University
Protein structure and function.

C. G. Bookhout, Ph.D.
Duke University Marine Laboratory
Staff
Effects of controlled environmental factors on the development of estuarine and oceanic crustacea.

Marit Christiansen, Ph.D.
University of Oslo
Oslo, Norway
Visiting Professor
Salinity and temperature effects on crab larvae, and effects of the larvicide ZR 515 on the development of crab larvae in various salinities and temperatures.

John D. Costlow, Ph.D.
Duke University Marine Laboratory
Staff
Effects of controlled environmental factors on the development and distribution of estuarine and oceanic crustacea; the Effect of cyclic temperature on larvae of marine invertebrates, and Studies on molting and growth in larval and adult barnacles and larval decapods.

Richard B. Forward, Ph.D.
Duke University Marine Laboratory
Staff
Investigations of the photobiology of dinoflagellates and larval crustaceans.

I. E. Gray, Ph.D., Professor Emeritus
Duke University Marine Laboratory
Director, Reference Museum
Preparation of atlas of marine benthic organisms.

John Gutknecht, Ph.D.
Duke University Marine Laboratory
Staff
Membrane physiology: permeability and transport properties of marine algae and phospholipid bilayer membranes.

Susan Huntsman, Ph.D.
Duke University Marine Laboratory
Research Associate
Phytoplankton nutrition and organometallic complexes in the sea.

Charles Johnson, Ph.D.
Duke University Marine Laboratory
Research Associate
Life history studies of protozoan parasites in the blue crab, *Callinectes sapidus*.

William Kirby-Smith, Ph.D.
Duke University Marine Laboratory
Curator, Reference Museum
Influence of food concentration on the growth of scallops.

John Lucas, Ph.D.
School of Biological Sciences
James Cook University of North Queensland
QLD. 4811, Australia
Visiting Professor
Cyclic temperature effects on gastropod larvae.

Kenneth Mitchell, Ph.D.
Department of Zoology
The University
Glasgow G12 8QQ, Scotland
Great Britain
Visiting Professor
Habitat selection in hermit crabs.

John G. Newton, B.A.
Duke University Marine Laboratory
Staff
Topography of the sea floor; Marine Biological Atlas of North Carolina

Genevieve Payen, Ph.D., CNRS
Laboratoire d'Evolution de la Faculte des Sciences de Paris
Paris, France
Research Associate
Control of sexual differentiation in crustacea.

Orrin Pilkey, Ph.D.
Duke University Department of Geology
Staff
Sedimentation on the northern Hatteras and Hispaniola abyssal plains;
Mapping of individual turbidity current flows.

Frank Schatzlein, Ph.D.
California State University
6101 E. 7th Street
Long Beach, California 90840
Visiting Professor
Acclimation of the oxygen consumption of crab larvae to temperature.

Pablo Schmiede, M.S.
Laboratorio de Zoologia
Instituto Ciencias Biologicas
Universidad Catolica de Chile
Casilla 114-D
Santiago, Chile
Visiting Investigator
Seasonal patterns in the larval development of *Emerita talpoida* (Say).

Richard B. Searles, Ph.D.
Department of Botany
Duke University
Staff
Study of the benthic communities on the continental shelf using facilities of R V *Eastward*, and a descriptive study of the epiphytic algae which grow in the sounds on the blades of eelgrass and other marine angiosperms.

J. Bolling Sullivan, Ph.D.
Duke University Marine Laboratory
Staff
Comparative aspects of protein chemistry.

John P. Sutherland, Ph.D.
Duke University Marine Laboratory
Staff
Experimental studies on the dynamics of fouling communities.

GRADUATE STUDENTS ENGAGED IN THESIS RESEARCH

Mary Bisson, B.A.
Department of Botany
Duke University
Membrane physiology.

John Commito, B.A.
Department of Zoology
Duke University
The regulation of estuarine soft bottom community structure.

Timothy Cowles, M.A.
Department of Zoology
Duke University
Feeding interactions among zooplankters.



Thomas Fisher, B.A.
Department of Zoology
Duke University
Physiological ecology of marine suspension feeding organisms.

David Hastings, B.A.
Department of Physiology and Pharmacology
Duke University
Membrane transport processes in marine algae.

Duncan Howe, B.A.
Department of Zoology
Duke University
Gill membrane transport in toadfish, *Opsanus tau*.

Burton Jones, B.S.
Department of Zoology
Duke University
Modeling of phytoplankton growth in nutrient-rich, unconditioned seawater.

George Lapenas, B.A.
Department of Zoology
Duke University
Oxygen permeability of the teleost swim bladder.

Walter Nelson, B.A.
Department of Zoology
Duke University
Community dynamics of the epifauna of eelgrass beds.

Lloyd Petrie, B.S.
Department of Chemistry
Duke University
Complexometric methods of analysis for describing and evaluating effect of speciation in the ocean.

Sharon Smith, M.S.
Department of Zoology
Duke University
Copepod nitrogen excretion as a process in estuarine nutrient cycles.

Walker Smith, B.S.
Department of Botany
Duke University
The dynamics of phytoplankton excretion.

Ken Susman, B.S.
Department of Geology
Duke University
Geologic history of Shackleford Banks.

GRADUATE STUDENTS HAVING RECEIVED DEGREES IN 1973-1974.

Evelyn B. Haines, Ph.D.
Department of Zoology
Duke University
Processes affecting production in Georgia coastal waters.

David Louis Harame, M.A.
Department of Zoology
Duke University
An ultrastructural study of the organ bellonci and frontal filaments in first stage nauplius of *Balanus improvisus*.

Lynda H. Murphy, Ph.D.
Department of Zoology
Duke University
Antiquity of the abyssal fauna.

Research Technicians

Shirley Bourne, M.A.
Michael Bradley, M.S.
Clarke Edwards, M.S.
Janet Elliott, B.S.
Gerald Godette, B.S.
Teri L. Herbert, B.S.
Sally Herring
David Johnson, B.S.
Charles McKenney, M.S.
Karen Johnson, B.A.
Doris King, B.A.
Louise Pennell, B.S.
Rebecca C. Piver, B.S.
Patrick Whaling

SUPPORT STAFF

Brenda Bright
Secretary

David L. Bunting
Senior Draftsman

James Chadwick
Light Equipment Operator

Claudia O. Davis
Housekeeper

Clifton Davis
Carpenter

Helen Davis
Housekeeper

James M. Davis
Oceanographic Party Chief

Janet A. Ely
Administrative Secretary

Annie C. Fulford
Housekeeper

Terry Fulford
Painter

Dianne Gagnon
Senior Accounting Clerk

Catherine Gibbs
Housekeeper

Olive C. Godette
Senior Housekeeper

Horace Holland
Mechanic

William Hunnings
Electronic Technician

Dorothy T. Johnson
Secretary

Ellen Jones
Clerk Typist

Mary Fond Jones
Secretary

Fred L. Kelly
Oceanographic Party Chief

Mamre Knight
Secretary

Lilian Lorenzsonn
Clerk Typist

Estelle G. Merrell
Administrative Secretary

I. Grayden Moore
Carpenter

Herman Myers
Senior Refrigeration and
Air-Conditioning Mechanic

George A. Newton
Oceanographic Party Chief

Robert Nolen
Housekeeper

George S. Robinson
Boat Operator

Ruthella Rozier
Senior Clerk Typist

Sylvia Springle
Senior Sponsored Programs Clerk

Sophia D. Turnage
Junior Buyer

Jean S. Williams
Library Assistant

James L. Willis
Boat Serviceman/Operator

R V EASTWARD Personnel

Ragnvald P. Sandoy, Master
Harold W. Yeomans, Chief Mate
Curtis Nelson, Chief Engineer
Harold G. Willis, Second Assistant Engineer
James Harker, Second Mate
Clyde R. Everett, Seaman/Messman
Susan Barker, Seaman
John Fluhart, Seaman
Delmas L. Guthrie, Seaman
Curtis A. Oden, Bosun/Deck Engineer
Benjamin H. Smith, Cook/Messman
Howard L. Wilson, Steward/Cook
James Robinson, Wiper













APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY SUMMER SESSION

Name .....
Please Print

Date .....

Social Security No. .....

Reserve a place for me in the following course(s): (Only one 6-unit course per term will be permitted; first and second choices may be indicated.) Each applicant should submit a transcript of grades to the Director.

FIRST TERM:

Course Number	**Title of Course**
.....	.....

SECOND TERM:

Course Number	**Title of Course**
.....	.....
.....	.....

THIRD TERM:

Course Number	**Title of Course**
.....	.....
.....	.....

Fees will be paid by: Self ..... Other .....

Reserve a room: TERM I ..... TERM II ..... TERM III .....

Attended Summer Sessions at Duke University Marine Laboratory: Yes..... No.....

Years .....

Request grade(s) be applied toward:
Undergraduate credits .....
Graduate credtis .....
General (unclassified) .....

If teacher: List name and address of school .....
.....
.....

If college student, list:
Undergraduate ..... Year .....
Graduate ..... Year .....

Name and address of School:
.....
.....
.....

Male .....Female..... Married..... Single.....

Colleges and/or universities attended and degrees: Degree .....

.....

.....

Current address

Street ..... Rural Route or P. O. Box .....

Post Office ..... City ..... State ..... Zip .....

Forwarding address

Street ..... Rural Route or P. O. Box .....

Post Office ..... City ..... State ..... Zip .....

Mail to:
Director
Duke University Marine Laboratory
Beaufort, North Carolina 28516

APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY SPRING SEMESTER MARINE SCIENCES PROGRAM FOR UNDERGRADUATES

Please type or print.

Date .....

1. Name .....
last first middle

2. Social Security Number ..... Sex: Male ..... Female .....

3. Date of Birth: Month .....Day..... Year .....

4. A. Current mailing address:

City ..... State ..... Zip.....

Area Code ..... Telephone Number .....

B. Permanent or home address:

City ..... State ..... Zip.....

Area Code ..... Telephone Number .....

5. A. Present marital status: Single ..... Married .....

If applicable, give number of dependent children .....

B. Name and address of next of kin:

Name .....Relationship.....

Address ..... City ..... State..... Zip.....

Area Code ..... Telephone Number .....

6. A. Duke University undergraduate student:

Trinity College of Arts and Sciences .....

Engineering .....

B. Special student desiring transfer credit:

Name and address of home institution

.....

City ..... State ..... Zip .....

C. Major department ..... Class .....

continued on reverse side

7. The following persons have been requested to mail letters of recommendation to the Director of the Laboratory:

A. Name ..... Position .....

.....

City ..... State ..... Zip .....

Area Code ..... Telephone Number .....

B. Name ..... Position .....

.....

City ..... State ..... Zip .....

Area Code ..... Telephone Number .....

8. Transcript(s) will be sent by the following institutions(s):

.....

.....

.....

9. Have you ever been placed on probation or suspended or dismissed from any school?

Yes ..... No ..... (If yes, please explain below.)

Mail application to: Director
Duke University Marine Laboratory
Beaufort, North Carolina 28516



Bulletin of Duke University The Marine Laboratory Vol. 47 No. 2 October 1974



1975-1976
BULLETIN OF
DUKE UNIVERSITY

The Graduate School of Business Administration



Bulletin of Duke University

The Graduate School of Business Administration

1975-1976

Durham, North Carolina 1974

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Degree Programs

Most students completing graduate work in business administration in the last half of the seventies will begin careers that will span several decades. We envision this period to be one of rapid and radical change. We are of the opinion that an educational program designed to study present day business problems and approaches to their solution is not adequate. The problems which organizations will face are unpredictable, and the solution techniques which will be available may be unknown at the present time. Our graduate programs are, therefore, designed to help the student develop a base from which he continues to learn. Our programs stress concepts and analytical reasoning while providing the student with a knowledge of the current status of business practice and decision models which are used by managers in leading organizations.

The Master of Business Administration program is designed for persons desiring to embark upon a career in management who can devote full time to their education for two academic years. The Master of Science in Management program is designed for persons who concurrently hold a position in management and who wish more formal education. This program requires part-time study for two complete calendar years. The Doctor of Philosophy program is designed primarily for those persons desiring a career in research and teaching in the field of business administration. The Ph.D. degree requires a minimum of three years for persons who enter the program without prior graduate study.

The Master of Business Administration

The Duke M.B.A. degree is designed to meet the challenges of rapid change in our society through emphasis on concepts and analytical reasoning. The student is continually asked to structure unstructured situations and to propose solutions to complex problems. To provide a basis for this approach to learning, the first year of the program is devoted to developing a working

knowledge of economic principles, principles of organization and behavior, accounting systems, and quantitative methods for the solution of management problems.

The particular focus on concepts and theory produces special qualities in the Duke M.B.A. candidate. By studying managerial theory and economic principles, the student acquires the capability of assuming responsibility in a wide variety of specific assignments within any organization. By studying the problems of economic enterprise in an integrated fashion, he acquires the capability of viewing decision-making from the perspective of the entire organization rather than from the narrow viewpoint of a single function or discipline. By studying the strategy of the firm, he acquires the capability of contributing effectively to the strategic planning process in an organization and to the implementation of its plans. By studying analytical tools and problem structures, he acquires the capability of identifying the common form of problems that in many respects appear to be different and to grasp quickly the essential nature of new problems with which he has limited experience.

Outline of the Curriculum. The M.B.A. degree requires four semesters of full-time work, totaling 64 semester-hours of graduate course credit. On rare occasions students who have prepared themselves in a particular subject beyond the standard entering level will be allowed to substitute more advanced work for one or more of the core courses. In the summer between the first and second years, the M.B.A. student is expected to gain practical experience through related employment. Aside from its obvious financial benefits, this experience should aid the student in his selection of second year electives, possibly including the practicum. In many cases, the student electing the practicum will select his topic and begin work on it during the summer.

First Year Program. Course work for the first year of the M.B.A. program provides the basic knowledge required to understand and to analyze the operations of an organization. The topics are arranged to reinforce knowledge gained in one course by applying that knowledge in other courses. This sequencing also permits basic assumptions, developed in a tight, theoretical structure in one area, to be related and examined in subsequent work in other areas.

The courses are organized to permit specific problems from the functional areas of marketing, production, finance, and personnel to be examined in terms of the more general concepts under consideration. The subject matter of the separate courses is coordinated to help the student understand the interrelated aspects of the functions within the organization.

The first year program includes:

First Semester

BA 300	Managerial Economics I	5 units
BA 310	Mathematics for Management	5 units
BA 320	Organization Theory and Management I	3 units
BA 330	Accounts Systems I	3 units
		16 units

Second Semester

BA 311	Statistical Analysis for Management Decisions	4 units
BA 312	Operations Research	3 units
BA 321	Organization Theory and Management II	3 units
BA 331	Accounting Systems II	3 units
BA 341	Managerial Economics II	3 units
		16 units

Second Year Program. The third semester is designed to permit an in-depth study of the functional areas of the organization, and the study of information systems facilitates the understanding of the interrelationships that exist among these functions. The work of this semester is structured to help the student observe specific needs for information at the same time he is studying the general subject. Strategic planning is developed during the semester with the aid of a business game. The game allows the student to study in depth the decisions required within a single function and to study the impact of a single decision on the entire firm. During this semester the study of external influences on the firm continues with a course on its legal environment. The required courses are:

Third Semester

BA 349	Legal Environment of the Firm	2 units
BA 360	Strategy of the Organization I	2 units
BA 361	Market Strategy	3 units
BA 362	Financial Strategy	3 units
BA 363	Operations Strategy	3 units
BA 364	Management Information and Control Systems	3 units
		16 units

In the fourth semester the focus of the students' study is again on strategic planning and also on issues of public policy. The three electives in the fourth semester permit the student to select an area for more concentrated study. At this point, the skills acquired in the previous three semesters are brought to bear on particular problem areas, as the student works toward applying his knowledge to problems that organizations currently face. The courses are:

Fourth Semester

BA 350	Public Policy of the Firm	3 units
BA 365	Strategy of the Organization II	4 units
	Electives	9 units
		16 units

The M.B.A.-J.D. Program

The School of Law and Business Administration offer a combined M.B.A. and J.D. program that can be completed in four academic years. The first two years are allocated to a full year in each program in either sequence. The latter two years are devoted to an integrated program that meets the requirements for completion of both the M.B.A. and J.D. degrees. Both degrees are awarded upon successful completion of the combined program.

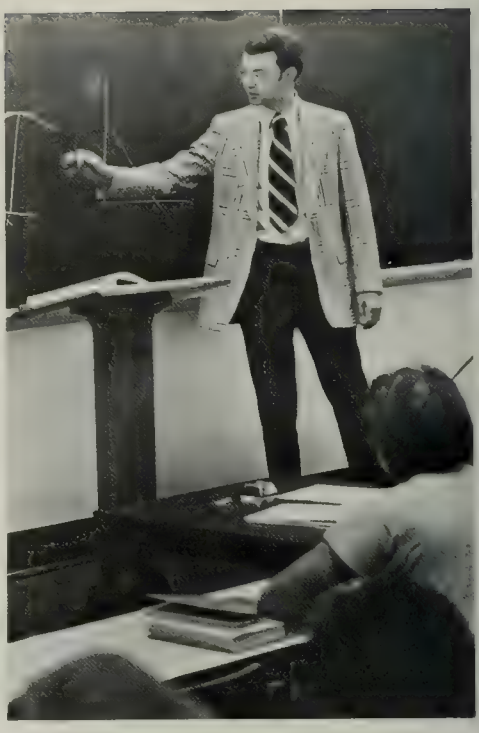
To apply for admission to this program, students must submit applications for both the M.B.A. and the J.D. programs. Additional information about the program and application procedures may be obtained on request from the Director of Admissions of the Graduate School of Business Administration.

The Master of Science in Management

For some students, combining graduate study with work experience provides more effective professional development than full-time study. The Duke Master of Science in Management degree program serves this need by







offering a sound education in management, and, at the same time, allowing the student to continue in a managerial or administrative position.

The Master of Science in Management program contributes to the development of promising managers as they attempt to improve the performance of the organizations in which they work. More specifically, the M.S.M. program is designed to teach the principles and the tools of managing an economic enterprise.

The M.S.M. program begins with a set of core courses in which the student acquires the tools of economic analysis, learning to view the firm as an economic entity, to analyze the firm in terms of its components, and to recognize the influences of the larger environment in which the firm exists. These basic concepts lay the foundation for the construction and application of useful economic models in several arenas, enabling the student to contribute to the solution of a variety of problems in his firm.

The program continues with an examination of the typical problems of economic enterprise, introducing the student to the functional areas of the firm and describing contemporary managerial practice. The student is taught to recognize the relationships among the specialized functional areas and to apply economic analysis to the solution of typical management problems.

The program culminates in a series of elective courses in which the student refines his knowledge and skills by studying one or more management disciplines in further detail.

This education in management—emphasizing economic principles and problem-solving tools—improves the manager's ability to learn from events in his working environment, to view decision-making from an integrated perspective, and thus to provide effective leadership in a management role.

Completion of the program usually requires twenty-four months of study, with classes scheduled Monday and Thursday each week from 5:00 to 9:00

p.m. Additional information about admissions and curriculum is available on request. The courses required in the program are listed below:

Courses Required

MS 300	Managerial Economics	4 units
MS 308	Calculus for Management	2 units
MS 310	Quantitative Methods	4 units
MS 311	Statistics	4 units
MS 312	Operations Research	4 units
MS 320	Organization Analysis and Design	4 units
MS 330	Accounting and Control Systems	4 units
MS 350	External Environment of the Firm	4 units
MS 360	Planning and Control Problems of the Firm	8 units
	Electives	12 units
		50 units

The Doctor of Philosophy

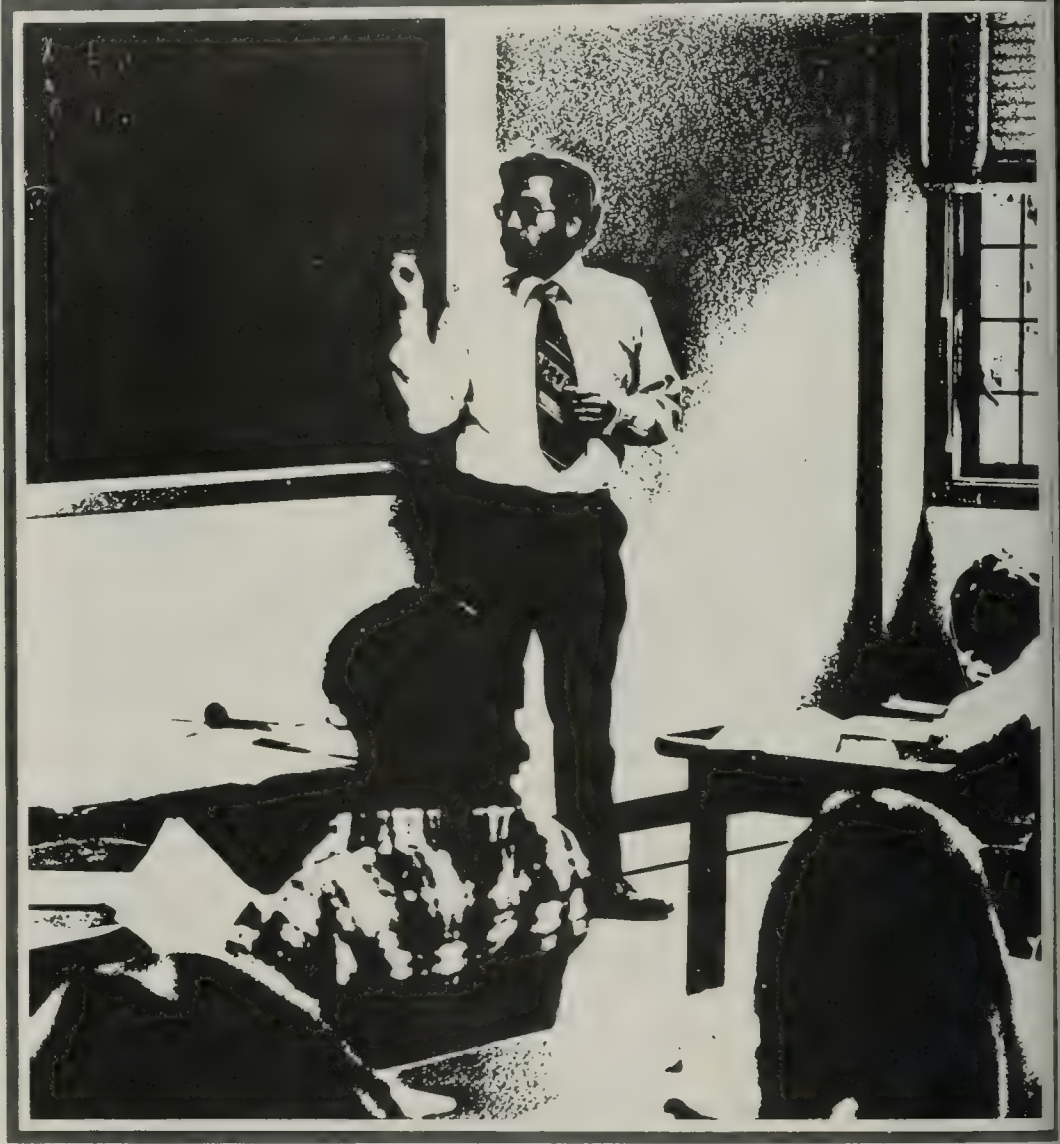
The purpose of the Ph.D program is to prepare candidates for research and teaching careers at leading educational, governmental, and corporate institutions. Students are encouraged to participate in the research activitives of the faculty and other students through seminars and special projects.

Course Requirements. The program accepts students with a bachelor's degree and usually lasts three to four years. Prerequisites for the program include a one year course in calculus, one course in linear algebra, and proficiency in a scientific computing language. The specific program of study is determined by the student and his faculty adviser, subject to the approval of the Director of the Doctoral Program. Generally, the first three semesters of study closely parallel those in the M.B.A. program. They serve to impart an integrated viewpoint of the marketing, financial, operational, and informational aspects of organization management based on rigorous foundations in economic theory, organization theory, accounting, optimization theory, and mathematical statistics. Subsequent study is devoted to developing knowledge of a research literature in each of two areas related to management. The extent of this knowledge should permit the student to begin contributing to that literature. This concentration requirement is usually satisfied in an area when a student completes two elective courses in that area beyond those courses offered in the first three semesters of the Ph.D. program. Concentrations are usually closely related to dissertation work and may be effected through courses offered on a tutorial basis.

Preliminary Examinations. Economics theory, quantitative methods, and an elected field of administration are the areas covered by the preliminary examinations. Usually, these examinations are taken upon completion of the formal course requirements, at about the time that serious work on the dissertation is beginning. These examinations are intended to provide evidence of the student's depth of understanding in the above areas and of his capability to complete the Ph.D. program.

Doctoral Dissertation. The doctoral dissertation is expected to be original research in some area of theory, analytic methods, or administrative application related to improvement of the performance of economic organizations. The main purpose of the dissertation should be to contribute to knowledge pertinent to management of organizations.

Final Examination. The final examination is conducted orally and usually dwells primarily on dissertation-related matters.



Admission and Financial Information



Admission

An applicant for admission to the Graduate School of Business Administration should have earned a baccalaureate degree with a sufficiently good record to demonstrate his ability to compete successfully in a demanding course of study which requires logical and analytical reasoning. No undergraduate major is deemed preferable to any other if the course work includes some components which are directed toward the development of analytical skills.

Much of the work in the first semester assumes a knowledge equivalent to that ordinarily obtained in a year's study of the calculus. Students whose prior academic work indicates a deficiency in this area may be granted provisional admission. In such cases, the deficiency must be removed before matriculation. The Admissions Committee usually will indicate what specific work is needed. These courses can be taken at Duke or at any other accredited college or university.

Prior work experience is not considered essential for admission to the M.B.A. or Ph.D. programs; however, prior experience should be reported and in most cases is a positive factor in admission decisions. The M.S.M. program is specifically designed for persons employed in a full-time position; therefore, in this program, concurrent work assignment is an admission requirement.

Both admission and financial aid decisions are made to encourage students from all races, religions, national origins, and both sexes to matriculate in the Graduate School of Business Administration. Admission is based on merit, with the recognition that traditional credentials may be inadequate indicators in estimating merit of minority group applicants.

Application Information. An applicant may submit any information about prior academic or work experience in support of his application. The most valuable information is that which helps the Admissions Committee assess







the applicant's ability to succeed in the program and to contribute to the profession of management.

The minimum application credentials are:

1. A completed application form.
2. Two copies of all current transcripts from schools attended.
3. Before matriculation, two copies of final transcripts from each school attended.
4. Personal and professional recommendations.
5. Score on the Admission Test for Graduate Study in Business.
6. No fee is required to complete the application, but a nonrefundable tuition deposit of $50.00 is required upon acceptance of the offer of admission to the M.B.A. and Ph.D. program; $200.00 is required upon acceptance of the offer of admission to the M.S.M. program.

Any questions or requests for application materials should be addressed to the Director of Admissions, Graduate School of Business Administration, Duke University, Durham, North Carolina 27706.

Application Deadlines. An early admissions policy is followed in the Graduate School of Business Administration, and admission decisions are made as applications are completed. Usually, students should complete the application by March 1. Ten percent of the positions in the entering class are reserved for late admission in the latter part of the spring and summer.

Admission of Foreign Students. Fully qualified students from outside the United States are welcome at the Graduate School of Business Administration. They are encouraged to pursue normal degree requirements but may also be admitted for nondegree course work if the length of their stay in the United States does not permit time for the completion of degree requirements. In applying for admission, the foreign student should submit, in addition to the credentials required of all students, the following:

1. If his native language is not English, certification of ability to use English through scores on tests provided by the Educational Testing Service (TOEFL).
2. A statement certified by a responsible person that his finances are sufficient to maintain him during his stay at Duke University. (See the section below on tuition and other costs.)
3. A statement by a qualified physician describing the physical and mental health of the applicant.

Notification of Status. When the applicant has been accepted, he will be sent a letter of admission and an acceptance form. The process of admission is not complete until the statement of acceptance and the tuition deposit have been returned to the Director of Admissions, Graduate School of Business Administration.

Successful applicants will be offered either full or provisional admission. Provisional admission is offered to students who warrant admission but who need additional time to complete admission requirements. In each case the requirements must be met before matriculation.

Admission Test for Graduate Study in Business. The Admission Test for Graduate Study in Business, required of all applicants, is administered by the Educational Testing Service for a fee of $10. Detailed information about



the test and application forms may be obtained by writing directly to the Educational Testing Service, Box 966, Princeton, New Jersey 08540.

The examination is administered at many centers throughout the United States and abroad. Arrangements to take the test at an established center must be made two weeks before the test date (six weeks prior to test date at established foreign centers). The examination is given in November, January, March, and July. Special centers may be arranged for persons distant from established centers. Requests for such accommodations must be made at least three weeks prior to the selected test date. Fellowship applicants should take the test in November or January. Other applicants may take it as late as March, but the earlier dates are strongly recommended.

Financial Information

The forms of financial aid range from fellowships that provide both tuition and stipend to special loan programs. Several combinations of these two forms of financial aid are available and are awarded primarily on the basis of merit with financial need as an important factor in determining the amount of award or loan. The problems involved in evaluating the traditional credentials of some minority group applicants are given special attention.

Duke University participates in the Federally Insured Loan Program which permits the student to borrow funds for educational needs with a maximum of ten years to repay after graduation at 7 percent interest per year.

An interest subsidy is available from federal funds for all students who have demonstrated need on the Graduate and Professional School Financial Aid Service (GAPSFAS) form. In order to qualify for the interest subsidy from the government, a GAPSFAS form must be submitted. Under the subsidy the federal government will make the interest payments accruing during the periods of full-time study.

A small number of fellowships and assistantships are available to second year students who did not receive such aid during their first year. The specific number depends upon the performance of the individuals as well as the specific skills required in research and other projects in the school.

Usually, financial aid is not available to students in the M.S.M. program.

Financial Aid Application. Financial aid decisions are made as applications are completed, with the first awards being granted about March 1. To be considered for the full range of awards, applicants should complete both admissions and financial aid applications for fellowships and/or loans early.

The Duke Graduate School of Business Administration is a participant in the Graduate and Professional School Financial Aid Service (GAPSFAS). All applicants for financial aid must file a GAPSFAS form entitled "Application for Financial Aid for the Academic Year 1975-76." The GAPSFAS application may also be obtained from the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540, and should be filed no later than February 1, in order to ensure its arrival at Duke by March 1. It contains sections to be completed by the applicant, by the spouse or spouse-to-be, and by the applicant's parents. The student must complete the applicant and spouse sections to be considered for aid, fellowship, or loan at the Graduate School of Business Administration at Duke University.

Tuition and Other Costs. The following table shows tuition and fees for students in the Graduate School of Business Administration for the year 1975-1976. All charges for each semester are payable at the time of registration for that semester and are subject to change without notice.

Tuition (full semester program of 16 units—M.B.A. and Ph.D. degrees)	$1400.00
Tuition (full semester program of 8 units—M.S.M. degree)	850.00*
Late Registration Fee	10.00
Doctoral Candidates Fees	
Dissertation Binding Fee (3 copies)	15.00
Dissertation Microfilming Fee	25.00
In Absentia Fee (1 unit per semester)	78.00

*This is the fee for students entering the M.S.M. program in September, 1974.

After the day of registration, no refund of tuition will be made except in the event of death or involuntary withdrawal to enter the armed services; refunds will be made on a pro rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before classes begin: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, or fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

Annual expenses vary according to individual tastes, especially for family support, food, recreation, travel, and clothing. Estimates of basic annual expenses should include $2800 for tuition, approximately $250 for books, and a minimum of $393 for living accommodations.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.



General Information

The University

The James B. Duke Indenture of Trust of 1924 provided the means to transform a small, church-supported undergraduate college into a university of recognized quality among major American universities. The Indenture identified the need to include a school of business among the professional schools of the University. In 1969, the Graduate School of Business Administration was added to the professional schools of Law, Medicine, Engineering, Divinity, Nursing, and Forestry.

Students at Duke number 8,450 of whom 2,750 are enrolled in graduate-professional programs. The size and informal association among faculty and students in other professional schools and related areas of study provide an exceptional opportunity for graduate students to benefit from strengths throughout the University.

The Campus. The Duke campus is located in Durham, North Carolina, a metropolitan area of approximately 100,000 people near the center of the state. Duke is an integral part of the growing Research Triangle of the Piedmont section of North Carolina. The Triangle, an education-research complex, encompasses the resources of the several universities in Durham, Raleigh, and Chapel Hill. These cities provide opportunities and facilities for off-campus cultural, recreational, and social activities. The campus is also within a few hours of the mountains and beaches, providing skiing, swimming, boating, and other outdoor recreational activities.

The Library. The William R. Perkins Library is located opposite the Graduate School of Business Administration. The G.S.B.A. Reading Room and most of the collections from the basic disciplines related to management are in the Perkins Library. In addition to the two-million volume collection available there, students have access to Duke's Law and Engineering Libraries.



Computing Facilities. The Duke University Computation Center is intended to provide the University faculty and students with a facility for research and instruction in computing. The center is presently equipped with an IBM 360 Model 40 which is connected by high-speed lines to an IBM 370 Model 165 located at the Triangle Universities Computation Center in the Research Triangle Park. Of special interest to students in the M.B.A. program, are a medium speed card reader and line printer, located adjacent to the Business School, and the slow speed terminals for interactive computing, located in the Business School. These are the terminals most used by M.B.A. degree candidates for access to the Model 165.

Office of Placement Services. Duke University provides placement services for students and alumni. For those who register, on-campus interviews for permanent or summer employment can be arranged with representatives of a broad spectrum of American industry. Students often make plans to use the semester break and spring vacation for off-campus interviews.

Living Accommodations. Duke University maintains living accommodations for single graduate students.

Rooms in residence halls, spaces in Town House Apartments, or other rental units may be reserved by single applicants after acceptance by the

Graduate School, and after a $50 deposit has been paid to Duke University. Assignment priority is established by the date of receipt of completed housing applications with deposits in the Office of the Director of Housing Management. Regulations governing room and security deposits and occupancy of rooms and apartments will be provided by the Office of Housing Management at the time housing application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

Double-occupancy rental charge in the Graduate Center and in the Hanes Annex is $393 per academic year. Town House Apartments, between East and West Campuses, include thirty, two-bedroom units, each furnished for three graduate students. Two students occupy the master bedroom; the third occupies a smaller bedroom. A living room, kitchen, and one and one-half baths complete these comfortable, tastefully appointed living units. The rental rate is $617 per person for the academic year.

Duke University is building a 500-unit housing facility which will be known as Central Campus Apartments. Planned for completion in 1974, the complex will provide housing for married graduate and professional school students, single undergraduate and graduate students, and single and married students in allied health programs.

For single students, there are efficiencies, one-bedroom, and two-bedroom apartments that will be fully furnished. The apartments for married students will include a few furnished efficiencies, and a number of one-, two-, and three-bedroom units in which the kitchen, living room, and first bedroom will be basically furnished in such a way as to provide economy and convenience to eligible couples, while allowing for individuality.

The monthly rental rates for each type of apartment will be lower than those offered on the current housing market. For further information on these apartments, students should write to the Manager of Apartments and Property.

The Department of Housing Management is prepared to assist married graduate and professional students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and complex units are available in limited numbers from time to time.

Accepted applicants to the Graduate School of Business Administration will receive a packet of housing information upon return of acceptance of admission to the Graduate School.

Food Services. Food service on the East Campus is cafeteria style. The dining facilities on the West Campus include one straight-line cafeteria with multiple-choice menus, a free-flow service area which includes cafeteria counters as well as a grill, and a table-service dining room, the Oak Room, where full meals and *a la carte* items are served. The Cambridge Inn, a self-service snack bar, also located in the West Campus Union, is open from 9:00 a.m. until 12:30 a.m. each day except Saturday. All types of snack and sandwich items are available there. The Graduate Center has a cafeteria open at meal hours and a coffee lounge which is open until 11:00 p.m. Because of the large number of those served in the dining halls, it is not possible to arrange special diets for individual students.

The cost of meals is approximately $3.50 to $4.50 per day depending upon the needs and tastes of the individual.

Standards of Conduct. Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct. The University wishes to emphasize its

policy that all students are subject to the rules and regulations of the University as currently in effect or, as from time to time, are put into effect by the appropriate authorities of the University.

Any student in accepting admission indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University.

Motor Vehicles. Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of $20 for each automobile and $10 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least $10,000 per person and a $20,000 per accident for personal injuries, and $5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Medical Care. The aim of the University Health Service is to provide medical care and health advice necessary to help the student as a member of the University community. The main components of the Health Service include the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the Insurance Plan.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and their children. Charges for services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.

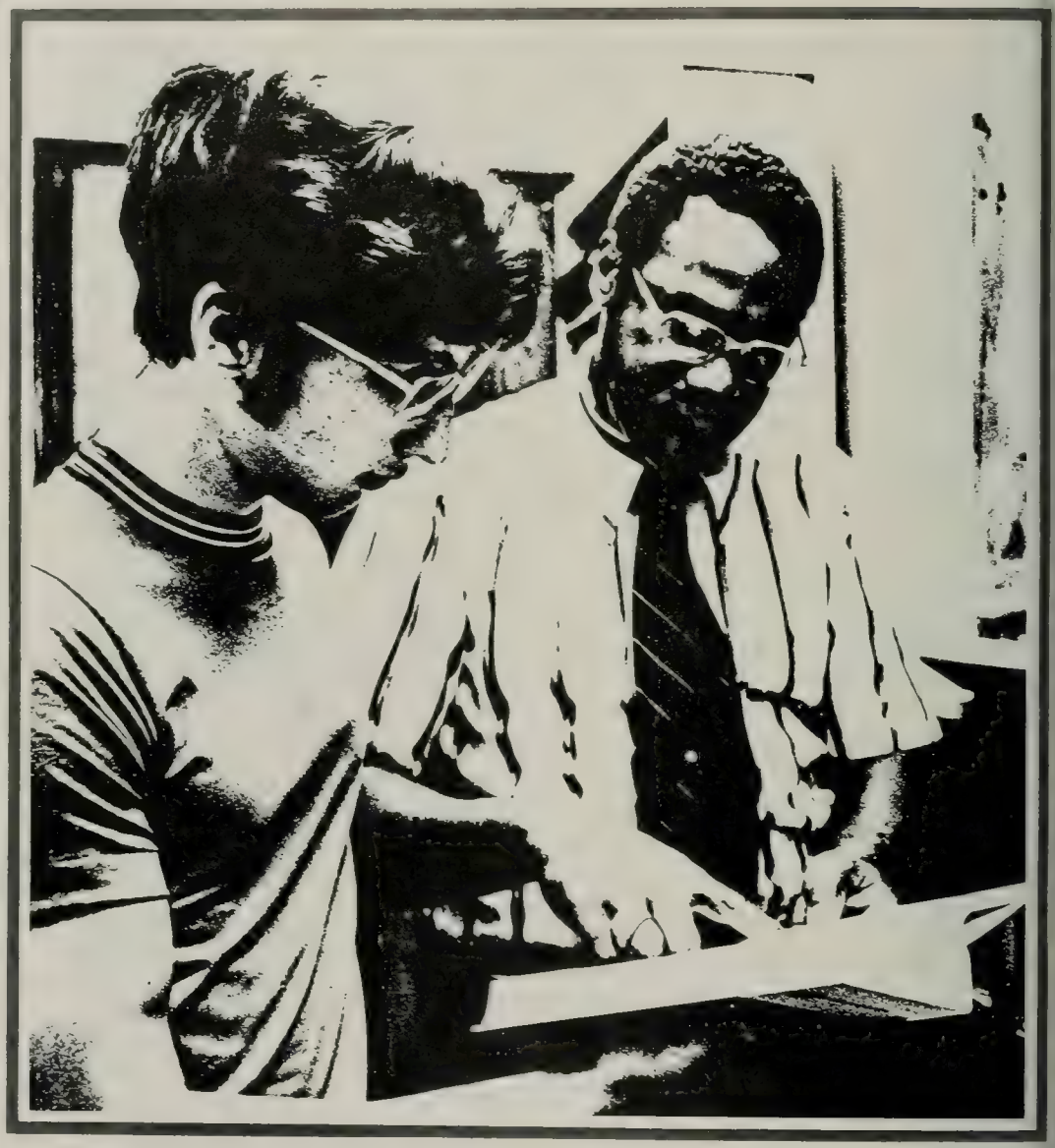
The University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment to be paid for by the student or covered by the Insurance Plan. Facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. To secure the benefits of these services a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until the student has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence.

Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined in the Infirmary. Hospitalization in Duke Hospital or other hospitals must be covered through private insurance policies or the Duke Student Accident and Sickness Insurance Policy. Financial responsibility for expenses incurred in the Emergency Room rests with the student.

The Student Mental Health Service, which is located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments with the Student Mental Health Service staff at no charge. Further interviews can be arranged, either with members of the Student Mental Health Service staff or with a variety of other local resources at a fee commensurate with the student's ability to pay.

The University has made arrangements with the Monumental Life Insurance Company for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. The 1974-1975 rate is $36.60 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Although participation in this program is on a voluntary basis, the University expects all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement. The Student Accident and Sickness Insurance Policy provides protection 24 hours per day during the full 12-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from August 26. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage. Information concerning this policy may be obtained from the Dean of the Graduate School of Business Administration.



Courses of Instruction

Master of Business Administration

300. Managerial Economics I. Develops the fundamental theory of the firm on which the analysis and planning of operations for an economic enterprise are based. Competitive price and non-price behavior in single and multiple market segments, cooperative market behavior, alternative market forms, the rationale for and form of government regulation, and production and investments are examined through the use of economic theory. Emphasis is on the identification and solution of planning problems of the firm in alternative market settings and development of students' abilities to employ economic reasoning in the decision-making process. Cases and problems are utilized to reinforce course material. 5 units.

310. Mathematics for Management. Develops the basic mathematical structures and techniques which provide a framework for understanding and analyzing decision problems of an enterprise. Specific topics include sets, relations, functions of several variables, classical optimization techniques, linear algebra, linear programming, and probability theory. Applications, cases and problems are used to illustrate the relevance of quantitative analysis in a decision context.

Conducted parallel with the foregoing is a subcourse on computer systems, which emphasizes the use of the computer for support of the decision-making process. Topics include computer technology, hardware, software, use of computer systems, and the PL/1 computer language. Several problems from other courses in the first semester are solved using the computer. 5 units.

311. Statistical Analysis for Management Decisions. Builds upon Business Administration 310 and extends to an examination of classical and Bayesian statistics as a framework and methodology for decision-making. Included are topics such as sampling theory, estimation, hypothesis testing,

regression and correlation analysis, utility theory, and statistical decision theory. 4 units.

312. Operations Research. Deals with the development and study of quantitative models which are useful for structuring and solving strategy problems of the firm, and which are used in the third and fourth semester strategy courses. Special emphasis is given to structuring problems in terms of quantitative models, generating solutions (using both analytical and simulation approaches) with and without computers, performing sensitivity analyses, implementing solutions, and developing a proper perspective about the role and usefulness of quantitative models in management decision processes. 3 units.

313. Advanced Operations Research. Deals with problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature serve as a basis for much of the class work. Students work in local industry, the University, the medical center, or in other cooperating agencies on operations research problems. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or the development of new ones. 4 units.

320-321. Organization Theory and Management I, II. Provides the first year M.B.A. degree student with an understanding of macroscopic (corporate level) and microscopic (small-group and individual level) organizational phenomena. At the macroscopic level, these courses are concerned with the study of organizations as socioeconomic-political systems for collective action imbedded in an uncontrollable environment. Specific topics include: (1) alternative theories of organization (with particular emphasis placed on modern, systems, and cybernetic approaches), and (2) introduction to organization design with particular emphasis placed on goal formation, performance measurement, decomposition, administrative mechanisms for coordination and control, and organization change and adaptation. At the microscopic level, these courses examine the social and psychological foundations necessary to understand the behavior and dynamics of individuals and small groups within organized settings as well as the administrative strategies available to the firm for influencing and modifying such behavior. To provide students with an empirically rich, cooperative-competitive learning experience, small-and large-group projects, business games, and cases may be used. Specific lecture topics include: (1) individual motivation and perception, (2) small group dynamics, and (3) informal organization. The assignment of specific areas to a particular course depends on the instructor. 3 units each.

330. Accounting Systems I. Introduces the student to the types of information requirements imposed on the firm by agencies in its environment and develops an understanding of the activities of the firm within the framework of a financial accounting system designed to satisfy these information requirements. The financial accounting system is treated as an input-output information gathering and reporting system which provides a conceptual model of the firm and reflects the impact of exchange transactions between the firm and its environment. Emphasis is given to the study of financial accounting reporting and measurement problems from a theoretical and an applied basis, using cases and topical problems in financial accounting as a foundation for the learning experience. 3 units.

331. Accounting Systems II. Establishes the relationships between the strategies of the firm as reflected in its planning activities and the impact of those plans on the data gathering, reporting activities, and operations inside the firm. The concept of the master budget is used to establish a basis for quantifying the planning activities of the firm and for developing a financial feedback and control system to serve as a mechanism for internal management and control. Specific topics include budgeting, standard costing, control in a programmed environment, capital budgeting, and funds analysis. Cases, together with a variety of brief problem exercises, are utilized as a basis for the development of the material in this course. 3 units.

333. Controllership. Develops systems for collecting and summarizing data in a manner which meets the requirements of the management team in controlling and planning operations. The function of the controller, as the center of synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters. 3 units.

334. External Reporting and Auditing. Builds on the information systems sequence of the first year and the public policy course in terms of developing requirements of the system for reporting to parties external to the firm. These parties may have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of and attesting to the reliability of data are studied in detail. 3 units.

341. Managerial Economics II. Focuses on developing an understanding of the economic environment of the organization with special emphasis on the determinance of price level, rate of growth, interest rates, and the level of aggregate income, employment, and output in the economy. Attention is also given to an examination of such current economic issues as inflation, international economic relations, and unemployment. The purpose is to develop a fundamental understanding of the economic environment of the organization, the types of government policies that affect the economic environment, and the impact that such policies have. 3 units.

349. Legal Environment of the Firm. Considers the legal environment of the firm with emphasis on the legal system, the process by which laws are formulated and changed, and the type and forms of legal constraints imposed on firms. Also examined are major legislation, court cases, and regulation by federal agencies which affect the firm's decisions. 2 units.

350. Public Policy of the Firm. Builds on the theory of market failure to describe the rationale for societal intervention in business activities and reasonable firm responses. Among the topics discussed are environmental action, monopoly relation, discrimination, poverty, consumer issues, and problems arising from shifts in demand and supply. The emphasis is on the role of the business firm in solving societal problems. 3 units.

351. Finance. Focuses on management of the financial affairs of the firm in its attempt to develop an optimal capital structure and includes: (1) the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and (2) the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 3 units.

353. Marketing. Applies the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems in-

volve a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 3 units.

355. Production. Provides the student with experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered—first, the design (or planning) of manufacturing systems and second, their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods and processes, facilities planning. Sub-topics under operation include cost, inventory and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 3 units.

360. Strategy of the Organization I. Focuses on the problems of formulating strategy for the organization, of decomposing aggregate strategy problems into manageable sub-problems, and of integrating and coordinating strategies designed for sub-problems into a consistent and implementable strategy for the organization as a whole. Specific attention is given to objectives of the organization in a complex environment, the objective setting process, short- and long-run strategy planning, methods for decomposing strategy planning, mechanisms for achieving integration and coordination of strategy, and the role of management information systems in strategy planning. 2 units.

361. Market Strategy. Focuses on the set of strategic problems associated with providing a set of products or services to consumers; and with procuring resources and services from suppliers in a manner that contributes to objectives of the organization. Specific attention is given to the analysis of market opportunities, product mix strategy, market segmentation, design of distribution and procurement channels, price and promotion strategy, and sales force decisions. 3 units.

362. Financial Strategy. Focuses on the set of strategic problems associated with the acquisition of financial resources from the external market



and their effective utilization and control within the organization. Specific attention is given to capital markets, evaluation of the firm, short-run resource planning (cash, inventory, receivables, and short and intermediate-term financing), and long-run resource planning (investment in long-lived assets, leasing, debt and equity financing, dividend policy, and the cost of capital). Institutional aspects of financial markets are emphasized only to the extent that they provide necessary insights into the problems of planning financial strategy. 3 units.

363. Operations Strategy. Focuses on the set of strategic problems associated with the design, operation, and control of the transformation processes utilized by an organization in producing goods and services for its external markets. Specific attention is given to systems design (product design, process design, capacity planning), system operation (production planning, scheduling) and system control (inventory control, quality control). 3 units.

364. Management Information and Control Systems. Focuses on the set of problems associated with the design and operation of the information systems necessary to support strategic planning of an organization and to support the organization's control system. Specific attention is given to the role of information in planning and control, the economics of information, the dynamics of information flows, technologies of information systems, information system design, data base construction and maintenance, and reporting systems. 3 units.

365. Strategy of the Organization II. Integrates the strategy planning and control process, organization design, and management information systems in order to achieve the objectives of the organization. Attention is given to strategy formulation, implementation, and control from the viewpoint of the organization as a whole and to the design of structures for the coordination and control of the organization. The cooperation and competitive relations of the firm with its environment are also investigated. 4 units.

390. The Practicum. The practicum is individually designed and is a major component of the second-year program designed to give the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of the real situation and the explicit formulation of the problem. That is, the problem should be stated with only the solution left to be developed. The important task of identifying and specifying the actual problem, perhaps after being directed to correct some undesirable symptoms, is an integral part of the practicum.

The practicum report should propose a solution to the problem specified and should contain the explanation and logic that supports those recommendations. This solution should be one that can be implemented and must not ask for human or nonhuman resources unavailable for use in the proposed solution. Further, where the solution of the problem is sensitive to the assumptions made, those assumptions must be realistic. 3 units.

391.1-.9. Special Topics in Management. Some elective courses may be offered as Special Topics in Management on an occasional basis depending on the availability and interests of students and faculty. Such courses might pertain to Management of the Nonprofit Enterprise, Advanced Organization Theory, the Multinational Enterprise, Marketing Research, Manpower Planning, or Management of Financial Institutions. 1 to 5 units.

Master of Science in Management

300. Managerial Economics. The fundamental theory of the firm on which analysis and planning of economic activity is based. Topics include: consumer demand, perfect competition, imperfect competition, capital theory, and welfare economics. Emphasis will be placed on the application of these theories to existing corporate resource allocation problems. 4 units.

308. Calculus for Management. An introductory treatment of calculus for graduate students in management. 2 units.

310. Quantitative Methods. Mathematical foundations for the quantitative analysis of management problems. Topics include: optimization, linear algebra, and probability. Prerequisite: Management Science 308. 4 units.

311. Statistics. Statistical foundations for the quantitative analysis of management problems. Topics include: classical statistics, Bayesian statistics, and regression models. Prerequisite: Management Science 310. 4 units.

312. Operations Research. Deterministic and probabilistic models useful in the analysis of management problems, with particular emphasis on model formulation, information requirements, model validation, sensitivity analysis, and utilization of model outputs in problem-solving. Topics include: mathematical programming, decision-making under uncertainty, and digital simulation. 4 units.

320. Organization Analysis and Design. A macroscopic study of organizations as socioeconomic-political systems for collective action imbedded in an uncontrollable environment. Specific topics include: (1) alternative theories of organization, with particular emphasis on modern, systems, and cybernetic approaches, and (2) introduction to organization design with particular emphasis on goal formation, performance measurement, decomposition, administration mechanisms for coordination and control, and organization change and adaptation. 4 units.

330. Accounting and Control Systems. The concept of the master budget is used to establish a basis for quantifying the planning activities of the firm and for developing a financial feedback and control system for internal management and control. After a brief introduction to and review of basic data accumulation systems, the topics for study include budgeting, standard costs and variance analysis, capital budgeting, and activity analysis. 4 units.

340. Controllership. The need for control and effective ways to provide it, primarily through budgetary processes. Special attention is devoted to project evaluation, control reports, and analysis of the variance between planned results and actual results. 4 units.

341. Marketing Management. Analysis of the firm's general market competitive and cooperative strategy problem. Specific problem areas include pricing, product and product line design, promotion, logistics, research, the relationships among these various problem areas, and their solutions. 4 units.

342. Financial Management. Sources and uses of financial resources for the firm. Capital budgeting, cash management, and the mix of external financing are examined in the context of attempts to achieve the optimal capital structure of the firm. 4 units.

343. Operations Management. Design of manufacturing systems— operating rules and policies. Topics investigated are choice of technology, design of

the physical system, development of operating procedures and decision rules for scheduling, inventory, cost control, quality assurance, and the interaction of manufacturing with other functions of the firm. 4 units.

349. Special Topics in Management. Examination of a specialized area in the field of management. Credit hours to be arranged.

350. External Environment of the Firm. An examination of the way in which society, through the mechanism of government, affects the decisions of business firms. Attention is focused on macro-economic, legal, and social factors in the firm's environment. 4 units.

360. Planning and Control Problems of the Firm. An introduction to the functional areas of the typical firm and an integrated treatment of the strategic problems involved in economic enterprise. 8 units.

390. Practicum. An applied project in which the student identifies, formulates, analyzes, and proposes a solution to a practical problem. The subject will ordinarily be a management problem from the organization in which the student works. 4 units.

Doctor of Philosophy

309.1-.9. Research in Managerial Economics. Credit hours 1-6.

319.1-.9. Research in Quantitative Methods. Credit hours 1-6.

329.1-.9. Research in Organization Theory and Management. Credit hours 1-6.

339.1-.9. Research in Information and Accounting Systems. Credit hours 1-6.

348.1-.9. Research in Public Policy and Social Responsibility. Credit hours 1-6.

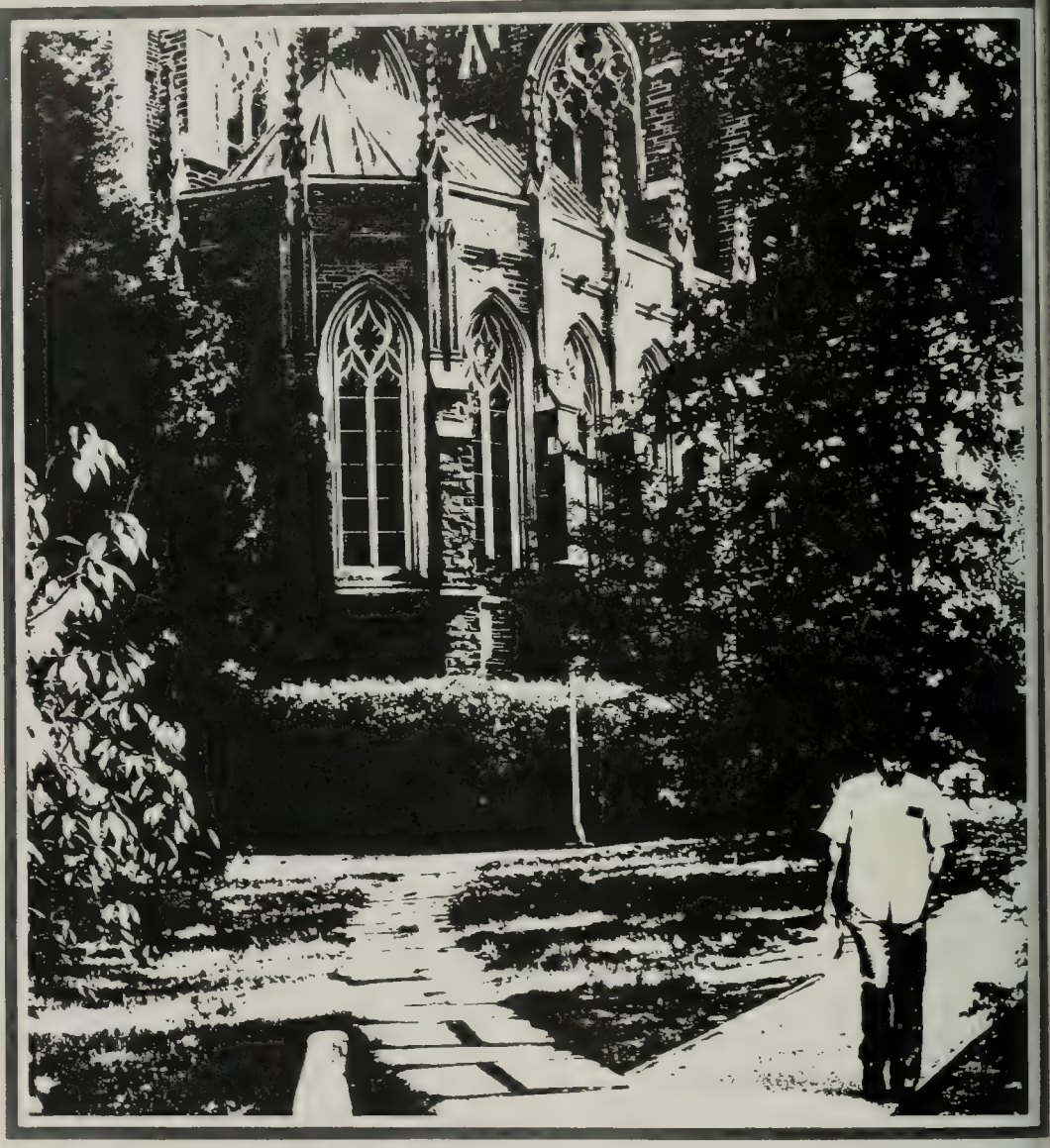
352.1-.9. Research in Finance. Credit hours 1-6.

354.1-.9. Research in Marketing. Credit hours 1-6.

356.1-.9. Research in Production. Credit hours 1-6.

392-393. Tutorial in Interdisciplinary Areas. Credit hours 1-6.

397. Dissertation Research.



Appendix

Faculty of the Graduate School of Business Administration

The faculty of the Graduate School of Business Administration has a diverse educational and professional background. This diversity provides the student the opportunity to explore wide ranging aspects of the environment in which he will live and work after completing his educational experience.

The student-faculty ratio in the School is maintained at a level permitting development of close professional relationships and encouraging individual assistance in academic and professional development. The student-teaching faculty ratio in the M.B.A. program is about seven to one. In addition, faculty engaged in major research projects and other teaching assignments are available to work with M.B.A. degree students. This balance is advantageous for both students and faculty in their joint work.

The faculty, the universities from which they received their formal education, their academic rank, and their main areas of research interest follow:



A. Rashad Abdel-Khalik, B.Com., M.B.A., A.M., Ph.D., *Associate Professor of Business Administration*

B. Com. Cairo University; M.B.A. (Accounting), A.M. (Economics), Indiana University; Ph.D. (Accountancy), University of Illinois. Financial and managerial accounting, management information systems.



Carole A. Aldrich, B.S., M.S.I.A., Ph.D., *Assistant Professor of Business Administration*

B.S. (Industrial Management), M.S.I.A., Ph.D. Carnegie-Mellon University. Economic models of the firm with special interests in the theory of dynamic problems. Public Policy.



Kenneth R. Baker, A.B., Ph.D., *Associate Professor of Business Administration*

A.B. (Engineering and Applied Physics), Harvard University; Ph.D. (Operations Research), Cornell University. Operations research, production planning, scheduling, and control.



Helmy H. Baligh, B.A., M.B.A., Ph.D., *Professor of Business Administration*

B.A. (Philosophy, Politics and Economics), Oxford University; M.B.A., Ph.D. University of California at Berkeley. Market theory and the design and control of general competitive and cooperative strategies. Analysis and design of vertical market structures (channels of distribution) for both business and social purposes.



Joseph Battle, B.S., M.S., Ph.D., *Associate Professor of Business Administration*

B.S. (Mathematics and Physics), North Carolina Central University; M.S., Ph.D. (Mathematics), University of Michigan. Development and application of mathematics in operations analysis and in information systems.



Richard M. Burton, B.S., M.B.A., D.B.A., *Associate Professor of Business Administration*

B.S. (Engineering Mechanics), M.B.A., D.B.A. University of Illinois. Systems analysis, operations research, and organization theory with applications to production planning, scheduling, capital budgeting, and design of organizations as a problem in system design.



Kalman J. Cohen, B.A., B.Litt., M.S., Ph.D., *Distinguished Bank Research Professor*

B.A. (Mathematics), Reed College; B.Litt. (Mathematical Logic), Oxford University; M.S., Ph.D. (Economics), Carnegie-Mellon University. Managerial economics, management of financial institutions, applications of quantitative methods to financial problems.



William W. Damon, B.S., M.B.A., Ph.D., *Assistant Professor of Business Administration*

B.S. (Mathematics and Physics), Purdue University; M.B.A., Ph.D. (Quantitative Analysis, Finance), Cornell University. Operations research and integrated planning of production and inventory, work force, marketing, and cash flow; corporate financial structure and investment theory.



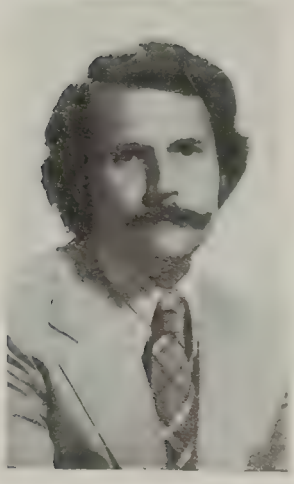
David C. Dellinger, B.S., M.S., Ph.D., *Associate Professor of Business Administration*

B.S. (Mechanical Engineering), Duke University; M.S., Ph.D. (Industrial Engineering-Operations Research), Stanford University. The conduct of operations research studies to solve problems and the implementation of the solutions.



Thomas F. Keller, A.B., M.B.A., Ph.D., C.P.A., *R. J. Reynolds Industries Professor of Business Administration*

A.B. (Economics and Accounting), Duke University; M.B.A., Ph.D. (Accounting), University of Michigan. Design of accounting information and control systems for use in meeting requirements of external reporting and modern management.



Arthur J. Kuhn, B.S., M.B.A., Ph.D., *Assistant Professor of Business Administration*

B.S. (Mechanical Engineering), M.B.A. University of Illinois; Ph.D. (Business Administration), University of California at Berkeley. Organization, system, and control theory as applied to the design of performance control systems for complex organizations and the historical and sociological analysis of readily comparable firms exhibiting significant performance differences.



Dan J. Laughhunn, B.S., M.B.A., D.B.A., *Professor of Business Administration*

B.S. (Engineering Mechanics), M.B.A. and D.B.A. University of Illinois. Production, finance, and operations research with emphasis on dynamic programming, capital budgeting, and long-range planning. Statistics and control theory.



Wilbur Garrett Lewellen, B.S., M.S., Ph.D., *Visiting Professor of Business Administration*

B.S. (Aeronautical Engineering), Pennsylvania State University; M.S., Ph.D. (Industrial Management), Massachusetts Institute of Technology. Business finance, executive compensation, taxation and public finance, portfolio management, and investment analysis.



Arie Y. Lewin, B.S., M.S., Ph.D., *Professor of Business Administration*

B.S. (Engineering), M.S. (Systems Engineering), University of California at Los Angeles; M.S., Ph.D. (Industrial Administration), Carnegie-Mellon University. Organizational behavior and design, public policy of the firm.



Wesley A. Magat, A.B., M.S., Ph.D., *Assistant Professor of Business Administration*

A.B. (Mathematics-Economics), Brown University; M.S., Ph.D. (Managerial Economics), Northwestern University. Managerial economics, public policy of the firm.



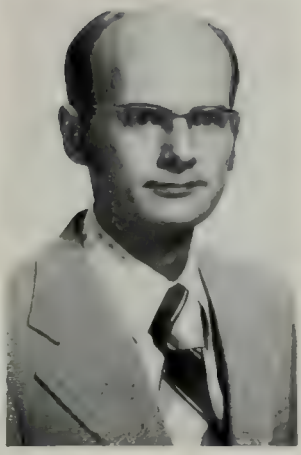
Steven F. Maier, B.S., M.S., Ph.D., *Assistant Professor of Business Administration*

B.S. (Industrial Engineering), Cornell University; M.S., Ph.D. (Operations Research), Stanford University. Operations research, computer science, finance, and statistical decision theory. Mathematical models of the corporate cash management problem, decomposition as a technique for solving linear models, and the design of a high level computer language.



Wayne Morse, B.B.A., M.B.A., Ph.D., *Associate Professor of Business Administration*

B.B.A. (Accounting), Siena College; M.B.A. (Managerial Economics), Cornell University; Ph.D. (Accounting), Michigan State University. Financial and managerial accounting, human resource accounting.



David W. Peterson, B.S., M.S., Ph.D., *Professor of Business Administration*

B.S. (Electrical Engineering), University of Wisconsin; M.S., Ph.D. (Electrical Engineering), Stanford University. Mathematical modeling with emphasis on business and economic problems. Special interests in information theory and dynamic systems.



W. Travis Porter, B.A., J.D., *Adjunct Professor of Business Law*

B.A. (English), University of North Carolina; J.D., University of North Carolina School of Law. Executive Vice President, Powe, Porter, Alphin and Whichard, P.A.



Robert Taylor, B.B.A., M.B.A., Ph.D., *Assistant Professor of Business Administration*

B.B.A. (Marketing), M.B.A. (Marketing, Management), Western Michigan University; Ph.D. (Organizational Behavior, Quantitative Psychology), University of North Carolina. Organizational behavior, manpower planning, managerial accounting.



James Vander Weide, B.S., Ph.D., *Assistant Professor of Business Administration*

B.S. (Economics), Cornell University, Ph.D. (Finance), Northwestern University. Finance, including portfolio theory, capital budgeting, financial markets and development of an optimal corporate financial structure and operating policy. Econometrics and mathematical analysis.



Julie Zalkind, B.A., M.S., Ph.D., *Assistant Professor of Business Administration*

B.A. (Mathematics), Mount Holyoke College; M.S. (Operations Research), Stanford University; Ph.D. (Operations Research), The Johns Hopkins University. Development of differential games and other aspects of operations research for application in analyzing competitive behavior in business and economics.

Officers of the Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
John O. Blackburn, Ph.D., *Chancellor*
Frederic N. Cleaveland, Ph.D., *Provost*
Charles B. Huestis, *Vice President for Business and Finance*
William G. Anlyan, M.D., *Vice President for Health Affairs*
Juanita M. Kreps, Ph.D., *Vice President*
J. David Ross, J.D., *Vice President for Institutional Advancement*
Victor A. Bubas, B.S., *Vice President for Community Relations*
Stephen Cannada Harward, A.B., C.P.A., *Treasurer and Assistant Secretary*
J. Peyton Fuller, A.B., *Controller*
Harold W. Lewis, Ph.D., *Vice Provost and Dean of Faculty*
John C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*
John M. Fein, Ph.D., *Vice Provost and Dean of Trinity College of Arts and Sciences*
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*
Joel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs*
Benjamin Edward Powell, Ph.D., *Librarian*
William E. King, Ph.D., *University Archivist*
Clark R. Cahow, Ph.D., *University Registrar and Acting Director of Admissions*
Olan Lee Petty, Ph.D., *Director of Summer Session*
Rufus H. Powell, LL.B., *Secretary of the University*
Charles Linn Haslam, J. D., *University Counsel*

Graduate School of Business Administration

Thomas F. Keller, Ph.D., *Dean*
Dan J. Laughhunn, D.B.A., *Director of Executive Development*
David W. Peterson, Ph.D., *Director of the Doctor of Philosophy*
Kenneth R. Baker, Ph.D., *Director of the Master of Business Administration Program*
Charles R. Fyfe, M.B.A., *Assistant Dean, Director of Student Services*

Calendar of the Graduate School of Business Administration

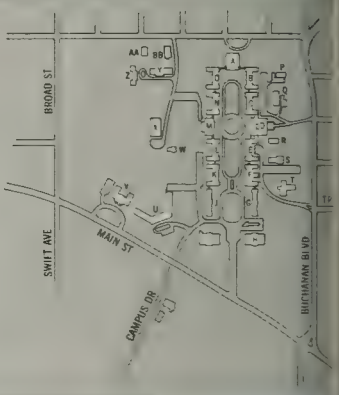
1975-1976

August		**January**	
29	Registration	12	Classes begin
September		**March**	
2	Classes begin	15	Spring vacation begins
		22	Classes resume
November			
26	Thanksgiving recess begins	**April**	
		23	Last day of classes
December		26-29	Final examinations
1	Classes resume		
5	Last day of classes	**May**	
8-12	Final examinations	9	Commencement

MAP OF DUKE UNIVERSITY

East Campus

- A Baldwin Auditorium
- B Bassett House
- C Brown House
- D Union Building
- E Faculty Apartments
- F Art Museum, Geology
- G Aycock House
- H East Duke Building
- I West Duke Building
- J Jarvis House
- K Carr Building
- L Giles House
- M Woman's College Library
- N Alspaugh House
- O Pegram House
- P Duke Press
- Q Infirmary
- R Ark
- S Crowell Building
- T Epworth Inn
- U Gilbert-Addoms House
- V Southgate Hall
- W Campus Center
- X Woman's College Gymnasium
- Y Asbury Building
- Z Biv ns Building
- AA Art Building
- BB Branson Building



West Campus

- A Duke Chapel
- B Divinity School
- C Gray Building
- D Perkins Library
- E Language Center
- F Old Chemistry Building
- G Davison Building School of Medicine
- H Hospital Main Entrance
- I Gerontology, D & T, Clinical Research
- J Duke Hospital
- K Sociology Psychology
- L Social Sciences
- M Allen Building
- N Few Quadrangle
- O Craven Quadrangle
- P Wannamaker Hall
- Q Crowell Quadrangle
- R Clock Tower Court
- S Kilgo Quadrangle
- T Union Building
- U Flowers Building Page Auditorium
- V Card Gymnasium
- W Indoor Stadium
- X School of Law
- Y Gross Chemical Lab.
- Z Biological Sciences
- AA Plant Environment Laboratory
- BB Physics Building
- CC Nuclear Laboratory
- DD School of Engineer
- EE Army Research
- FF Medical Center Res. Buildings
- GG Nanaline H. Duke M. Sciences Building
- HH Warehouse Shop
- II Bell Building
- JJ Hanes House School of Nursing
- KK Hanes House Annex
- LL Pickens Rehabilitat. Center
- MM Graduate Center
- NN Alumni House
- OO Commonwealth-Stud. Center
- PP Personnel Office
- QQ International House
- RR Personnel Office
- SS Education Improvem. Program, A Better Chance Pro.
- TT International Stud. Center
- UU Campus Stores Offic.
- VV Office of Institutiona Advancement
- WW Information Services Visitors Bureau
- XX Admissions Office
- YY Edens Quadrangle
- ZZ Wade Stadium





Bulletin of Duke University The Graduate School of Business Administration Vol. 47 October, 1974 Numb



1975
BULLETIN OF DUKE UNIVERSITY

Summer Session

Bulletin of Duke University

Summer Session

1975

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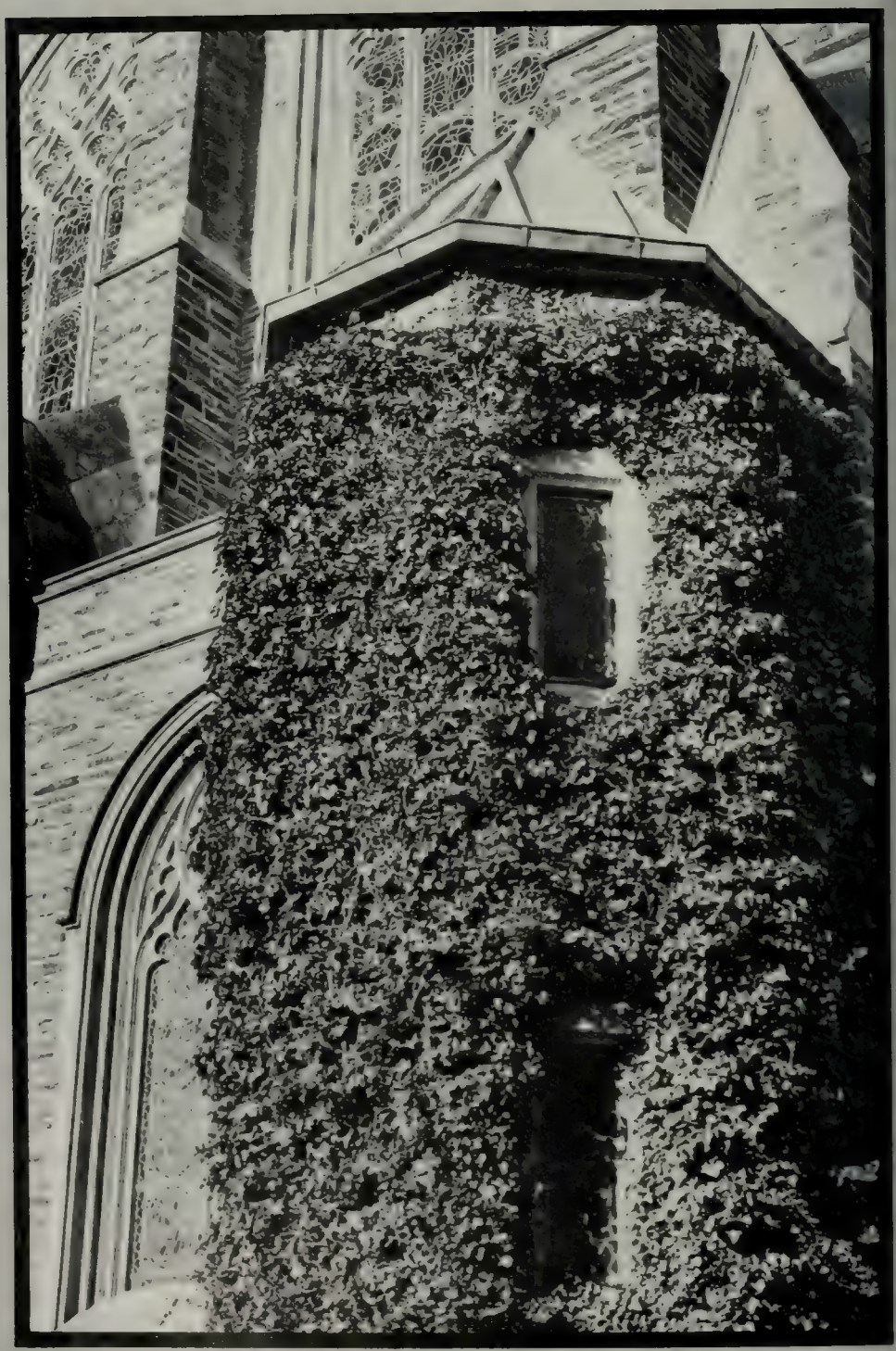
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Blankley, William F., Ph.D., *Assistant Professor of Botany*
Borinski, Ernst, Ph.D., *Visiting Professor of Sociology*
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Bronfenbrenner, Martin, Ph.D., *William R. Kenan, Jr., Professor of Economics*
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Burford, Walter W., S.T.M., *Assistant Professor of Religion*
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Carson, Robert C., Ph.D., *Professor of Psychology*
Cartwright, William H., Ph.D., *Professor of Education*
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Fowlie, Wallace, Ph.D., *James B. Duke Professor of Romance Languages*
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Friedrich, John, Ph.D., *Professor of Physical Education*
Fulbright, Evelyn, Ed.D., *Visiting Professor of Education*
Fulcher, J. Rodney, Ph.D., *Visiting Associate Professor of History*

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Gehman, W. Scott, Jr., Ph.D., *Professor of Psychology in Education*
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Hartwig, Gerald W., Ph.D., *Associate Professor of History*
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Holsti, Ole R., Ph.D., *George V. Allen Professor of Political Science*
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Jones, Buford, Ph.D., *Associate Professor of English*
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Kort, Wesley, Ph.D., *Associate Professor of Religion*
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LeBar, John, Ed.D., *Assistant Professor of Physical Education*
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Lockhead, Gregory, Ph.D., *Professor of Psychology*
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Martin, David V., Ed.D., *Associate Professor of Education*
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Meyers, Eric M., Ph.D., *Associate Professor of Religion*
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Miller, Martin A., Ph.D., *Associate Professor of History*
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Moore, Lawrence C., Jr., Ph.D., *Associate Professor of Mathematics*
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Myers, Roderick W., M.A., *Instructor in Physical Education*
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Nygard, Holger O., Ph.D., *Professor of English*
Oates, John F., Ph.D., *Professor of Classical Studies*
Olela, Henry, Ph.D., *Assistant Professor of Black Studies*
Palmer, Richard A., Ph.D., *Associate Professor of Chemistry*
Parker, Scott, M.A., *Technical Director of Summer Theater at Duke*
Partin, Harry, Ph.D., *Associate Professor of Religion*
Patrick, Merrell Lee, Ph.D., *Associate Professor of Computer Science*
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Pilkey, Orrin H., Ph.D., *Professor of Geology*
Pittillo, Robert A., Jr., Ed.D., *Associate Professor of Education*
Poteat, William H., Ph.D., *Professor of Religion*
Pratt, Sheila, *Instructor in Art*
Pratt, Vernon, M.F.A., *Instructor in Art*
Preiss, Jack J., Ph.D., *Professor of Sociology*
Price, James L., Jr., Ph.D., *Professor of Religion*
Raynor, Calla Ann, M.A.T., *Assistant Professor of Physical Education*
Reardon, Kenneth James, M.A., *Associate Professor of English*
Reiss, Edmund, Ph.D., *Professor of English*

Riebel, John D., M.A., *Assistant Professor of Physical Education*
Ripley, Dana P., Ph.D., *Associate Professor of Romance Languages*
Ritz, Michael, B.S., *Lecturer in Physical Education*
Rolf, Robert, M.A., *Instructor in History*
Rosen, Lawrence, Ph.D., *Associate Professor of Anthropology*
Rosenson, Leon, Ph.D., *Visiting Instructor in Zoology*
Roy, Donald F., Ph.D., *Professor of Sociology*
Salinger, Herman, Ph.D., *Professor of German*
Salmon, Michael, Ph.D., *Visiting Professor of Zoology*
Searles, Richard, Ph.D., *Associate Professor of Botany*
Shuman, R. Baird, Ph.D., *Professor of Education*
Smith, David A., Ph.D., *Associate Professor of Mathematics*
Smith, Grover, Ph.D., *Professor of English*
Smith, Peter, Ph.D., *Professor of Chemistry*
Smullin, Frank M., M.F.A., *Instructor in Art*
Steegar, David M., M.A., *Instructor in Romance Languages*
Stern, Henry R., Ph.D., *Assistant Professor of German*
Sullivan, James Bolling, Ph.D., *Assistant Professor of Biochemistry*
Sutherland, John P., Ph.D., *Assistant Professor of Zoology*
Swain, Myrtle, Ed.D., *Part-time Instructor in Education and Mathematics*
TePaske, John, Ph.D., *Professor of History*
Tetel, Marcel, Ph.D., *Professor of Romance Languages*
Tiryakian, Edward A., Ph.D., *Professor of Sociology*
Troy, Joan B., Ed.D., *Visiting Instructor in Education*
Utku, Senol, Sc.D., *Professor of Civil Engineering*
Vernon, John M., Ph.D., *Professor of Economics*
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Wells, Richard L., Ph.D., *Professor of Chemistry*
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General Information

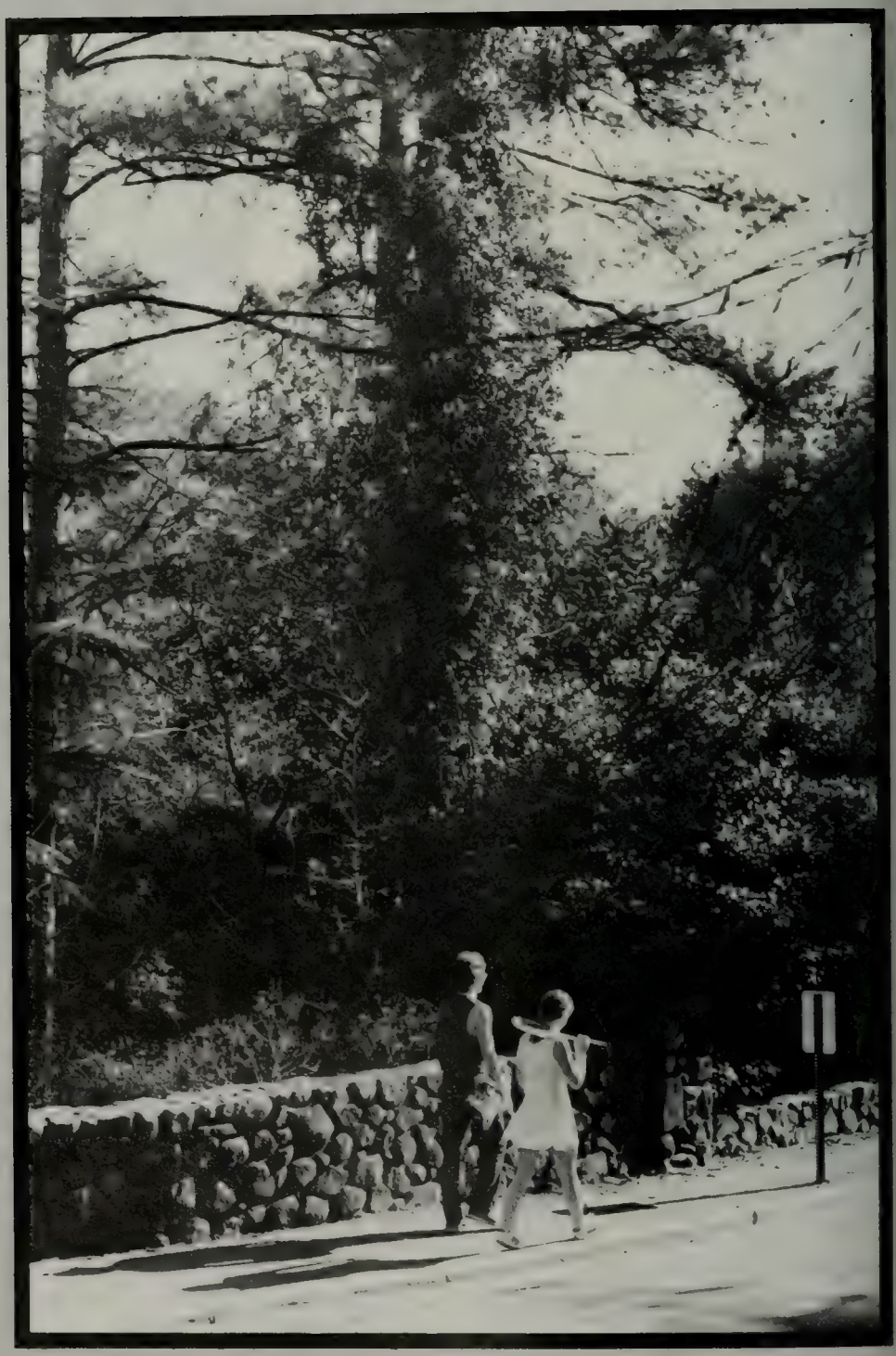


The Summer Program at Duke

The summer session at Duke University makes available to Duke students, to students from other universities and colleges, to teachers in elementary and secondary schools, and to other special students a notable program of instruction in many fields of knowledge, both academic and professional. Course programs offered during the summer are designed to meet special and particular needs as well as the more conventional requirements leading to specific degrees.

Postdoctoral research scholars may find the regular summer session courses useful for further study. The library facilities and the various laboratories may be valuable for postdoctoral residents. Graduate students who have been admitted to the Graduate School to study for the Master of Arts, Master of Education, and Master of Arts in Teaching degrees will find courses arranged in sequence from summer to summer to meet their requirements. Teachers from elementary and secondary schools who desire to earn credits toward the renewal of their certificates and who are interested in further teacher training in subject content and method may enroll in senior-graduate courses as special or unclassified students. Undergraduates of Duke University who desire to accelerate their programs may complete the work for a degree in three years by attending two or more summer sessions. Undergraduates from other colleges and universities may enjoy the special advantages of summer instruction at Duke and transfer credits earned to their own institutions.

Although the summer course program meets, in many departments, the needs of degree candidates, it goes beyond these limits in also presenting courses of wide general interest and, in addition, special non-credit lectures, conferences, institutes, and workshops. Duke University's ample and modern research facilities will be available during the summer to all properly qualified students. It is the hope of the University, of the summer faculty, and of the administrative officers that former students and new students will find increasing value in each summer spent at Duke.



Program Information



Freshmen in the Summer Session

Students admitted to enroll in September, 1975, may begin their study in Duke's summer session. Duke recognizes that study in the summer session is desirable and beneficial for many entering students. Some freshmen want to begin their college work with a light load of courses, and in a summer term, when two courses constitute a full load, these students take only a single course. Others take courses in the summer to accelerate their programs or to enrich their education with study not directly related to their career interests. A student who anticipates taking a heavy load of laboratory courses during the regular year may want to relieve his schedule by taking a science course in one or two terms of the summer session.

Freshmen will be accepted in the summer of 1975 to take one or two courses in the second term of the summer session (June 16 to July 17) and, if they wish, to take an additional one or two courses in the third term (July 18 to August 19). These students may choose among courses in anthropology, art, biology, Black studies, botany, chemistry, English, French, German, history, mathematics, political science, psychology, religion, or Spanish. Freshmen are housed in dormitories with other freshmen and upperclassmen and may take their meals in the University cafeterias. All students are eligible for medical and counseling services and may participate in the recreational programs and social activities.

Undergraduate Study

Students in the undergraduate college and schools of Duke University who desire to enrich or accelerate their academic study will find summer programs to meet their individual needs and interests. Special courses are provided which are not otherwise available to undergraduates; election of the usual courses may relieve an overload during the fall or spring terms. Summer programs also enable some students to attain provisional graduate status in the senior year or to graduate in less than four years.

By attending at least two terms of the summer session, it is possible for a student to earn credit for as many as 4 semester-courses. Instruction will be offered in the summer of 1975 in most departments and colleges. Specific requirements for degrees offered in the undergraduate colleges and schools may be obtained from the *Bulletin of Undergraduate Instruction.*

Divinity School Studies

Degrees of Master of Divinity and Master of Religious Education are administered by the faculty of the Divinity School. Students in these programs may register with the Summer Session Office for independent study in any one of the terms of the summer session or for the language courses which are listed under the heading Divinity School in this *Bulletin.* Persons desiring credit toward one of these degrees must be regularly admitted to the Divinity School and all courses taken by the student for Divinity School credit must be registered and approved by the Director of Academic Affairs of the Divinity School.

Graduate Study

Degrees and Requirements. The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Hospital Administration (M.H.A.), Master of Business Administration (M.B.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.). Specific requirements relative to admission, residence, major and related studies, languages, and thesis requirements may be obtained from the *Bulletin of the Graduate School.*

Candidates for degrees in the Graduate School desiring to have their degree conferred on September 1 must have completed all requirements for the degree as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree officially conferred at the following May Graduation Exercises. (Transfer of credit for work completed at other universities must be recorded by September 15.)

Summer Program for Graduates. Summer sessions offer an excellent opportunity to advance or complete programs of graduate study already undertaken, to begin study toward a graduate degree at Duke University, to acquire graduate training useful in professional advancement, or to study for personal satisfaction. The several departments offer a variety of graduate courses, as listed in later pages, given by members of the Duke faculty and visiting professors.

Unclassified Graduate Students. Any student who holds an A.B. or B.S. degree and who does not intend to earn an advanced degree at Duke University but who desires graduate work for professional or other reasons should apply to the Director of the Summer Session for admission as an unclassified student. Credits earned by an unclassified graduate student in graduate courses taken at Duke before his admission to the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better. This policy shall be effective with students entering the Graduate School in September, 1971.

Cooperative Program in Teacher Education. Thirty-five to forty selected graduates of liberal arts colleges who desire to prepare for high school teaching will be admitted to a special internship program at Duke University. This program is designed to prepare for a teaching career selected college graduates who did not prepare professionally for teacher certification as undergraduates. The cooperative program provides, for candidates who are chosen, graduate study in their special fields, professional courses, and carefully supervised observation and teaching experiences. One who completes the program successfully can achieve, within a period of fifteen months, a year of teaching experience, a Master of Arts in Teaching degree, and full certification as a teacher.

Candidates will begin the program at the opening of Term II of the 1975 summer session and complete it in August, 1976. They will spend two terms of the summer preceding and the summer following the year of teaching in residence at the University. During the school year 1975-1976 interns will be employed as regular teachers in cooperating public school systems. During this year they will receive full salary and will work under the joint supervision of the cooperating public school and the University. The program will meet training qualifications for the advanced or graduate teacher's certificate in many states. Participants in the program are expected to teach for a second year as fully certified teachers in the school in which they complete the internship.

The salary for the year of teaching will, in effect, constitute a substantial award to candidates selected for the program. Interns will benefit from Duke University's special tuition rate for teachers. Applicants will be considered, as are candidates for other awards, on a competitive basis. The best qualified applicants will be chosen on the basis of undergraduate record, recommendations, and evidence of interest in becoming high school teachers. Applicants are required to arrange interviews in connection with their applications. Application forms may be requested from the Dean of the Graduate School and should be submitted before February 15, 1975. Details concerning the program can be obtained by writing the Director, Cooperative Program in Teacher Education, Department of Education, Duke University.

Postdoctoral Research

Scholars engaged in postdoctoral research find it advantageous and sometimes essential to use the resources of the Duke University libraries during the summer. The University welcomes these visitors and makes living accommodations (dormitory space and dining facilities) available to them during the summer sessions from May 13 to August 19.



Special and Cooperative Programs



Cooperative Program

The long standing reciprocal agreement between Duke and the University of North Carolina is now effective for the summer sessions at both universities. To take advantage of this arrangement for either term of the summer session, the student registers each term for 3 units of credit at the home institution and 3 units representing the course to be taken at the other institution, for a total of 6 units. A nominal registration fee of $2 will be charged at the other institution. Credit so earned is not defined as transfer credit. This program applies to both graduate and undergraduate students.

Special Conferences and Courses

Special Programs for Teachers of Science and Mathematics. It is anticipated that the summer session will offer a number of special programs at the graduate level designed specifically for high school teachers of science and mathematics. For detailed information on the programs, teachers should write Dr. Sherwood Githens, Education Department, Duke University, Durham, North Carolina 27708.

Highlands Biological Station. Duke University holds a subscribing instructional membership in the Highlands Biological Station at Highlands, North Carolina, on the southern edge of the Blue Ridge Mountains at an elevation of 4,118 feet. The situation and the region offer an excellent opportunity for field studies and some laboratory work. A limited number of qualified students in botany and zoology may make arrangements to carry out research at this station.

Medical Mycology. A comprehensive course in medical mycology is offered during the month of July at the Duke University Medical Center. The class will meet daily Monday through Friday, July 7 through August 1, 1975.

The laboratory will be a major part of the course, and it will concentrate on the practical identification of both saprophytic and pathogenic fungi. Stu-

dents will participate in all aspects of diagnostic mycology from the collection of patient specimens and identification of organisms, through fungal serology and record-keeping. The lecture material will survey the mycology, immunology, pathogenesis, and epidemiology of all the pathogenic fungi. Another component of this course is the guest lectures. Several internationally recognized mycologists will be invited to meet with students and discuss their particular areas of expertise and current research interests.

The enrollment for the course will be limited to twenty students, and applications will be considered in the order received. A fee of two hundred dollars will be charged for this course; alternatively, a student may register in the summer session, pay the tuition required, and receive 4 units of graduate credit for the course. All inquiries should be addressed to Dr. Thomas G. Mitchell, Department of Microbiology and Immunology, Duke University Medical Center, Durham, N. C. 27710.

The Ministerial Course of Study School. In cooperation with the Board of Education and the Southeastern Jurisdictional Conference of the United Methodist Church, Professor Paul A. Mickey directs the Ministerial Course of Study School. This is not related to the regular Divinity School degree program, and no credit toward a seminary degree can be earned. The twenty-seventh session of the school is from June 23 to July 18. For further information write the Director, Box 4484, Duke Station, Durham, N. C. 27706.

Divinity School Summer Institute for Ministry. Seminars and clinics, running concurrently, for ministers, wives, and church leaders of all denominations will be conducted at the Duke Divinity School, June 30-July 4 and July 7-11, 1975. These are designed to supplement seminary education through one or two weeks of intensive training in academic and professional studies. No academic credit is given.

Sponsoring institutions make funds available for tuition. Other scholarships are available upon request. For full information write the Director of Continuing Education, Duke Divinity School, Durham, N. C. 27706.

Summer Drama Program. Duke's new interdisciplinary Program in Drama offers theater-oriented students and teachers an integral program of training in theater and dramatic literature during the first and second summer sessions.

The courses in practical theater, taught by members of the professional staff of Summer Theater at Duke, will offer formal instruction and supervision in all aspects of theatrical production from acting to scene design to publicity and management. In addition, a group of related courses in dramatic literature will offer the student a close study of the great plays of the past and present. Teachers and future teachers will be particularly interested in the new course in educational theater.

Please look under the course listings in Drama for further information. Detailed information on faculty, courses, productions, and auditions for Summer Theater at Duke may be obtained by writing Box 4941 Duke Station, Durham, N. C. 27706.

Southeastern Institute of Medieval and Renaissance Studies. Participation in the Southeastern Institute of Medieval and Renaissance Studies is open to those with scholarly interest in all areas of medieval and Renaissance studies, including (among others) art, aesthetics, history, literature, music, paleography, philosophy, and religion. The Institute consists of six informal seminars, each concerned with a topic of interest to students of the medieval and Renaissance periods. Each seminar is led by a senior fellow and has an







enrollment of about six participants, designated fellows. Each fellow participates in one seminar and has ample free time to devote to his own research. It is emphasized that the seminars are not courses but informal meetings to encourage the exchange of ideas and to stimulate participants in their own research. In most cases fellows will be beyond the Ph.D. level, but in some cases applications will be considered from advanced graduate students.

Annually the Institute alternates between the campuses of Duke University and the University of North Carolina at Chapel Hill. The seventh session, from June 30 to August 8, 1975, will be held on the Chapel Hill campus.

Teaching Sex Education. This evening course is designed to prepare teachers to present a sex education program to their students. The curriculum consists of a four week series of training seminars surveying biological, psychological, and ethical aspects of human sexuality. Instruction on design, organization, and implementation of education programs for students is provided. The curriculum has been organized by the Davison Society's Committee for Sex Education, Duke Medical Center. For further information contact: Adelbert L. Stagg, Box 3022, Duke University Medical Center, Durham, North Carolina 27710.



Resources for Study



Libraries

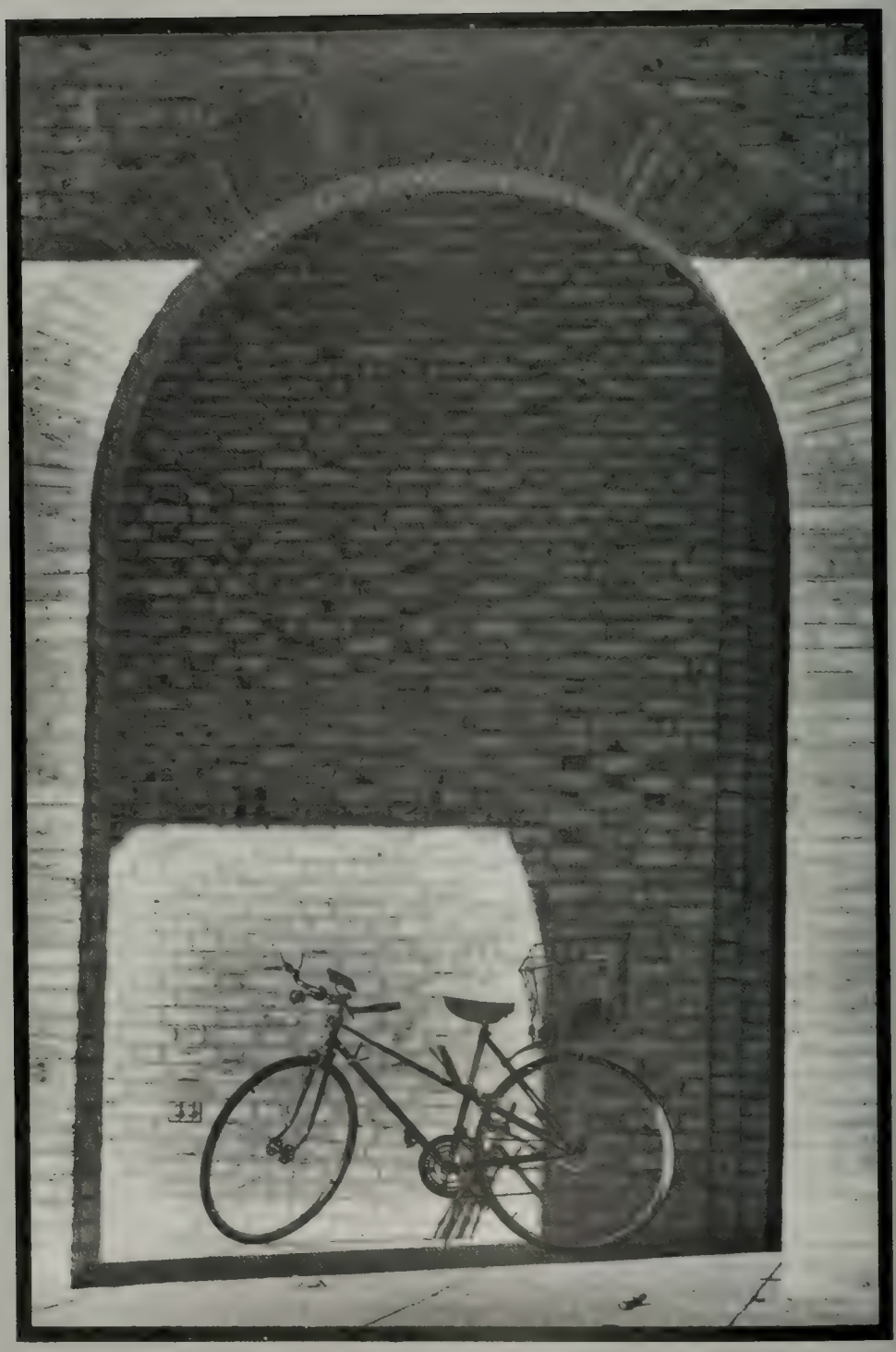
The William R. Perkins Library consists of the new research library building which was opened early in 1969 and the old building which was renovated in 1970. The complex has about 2,100 seats (700 of which are private carrels) and shelf space for 2,500,000 volumes.

On June 30, 1974, the University libraries, including nine school and six departmental collections, contained 2,530,124 volumes and 4,436,000 manuscripts. One hundred thousand volumes are added each year and about 15,000 periodicals are received regularly. Many rare and perishable materials which appeared in books, newspapers, periodicals, and manuscripts are available in microtext form and may be read in a special microtext reading room in the Perkins Library. Rare books and manuscripts have special quarters in the building, which are accessible to all members of the University community.

All libraries of the University are open for use throughout the summer. Guides to the Perkins Library for faculty and graduate and undergraduate students are available upon request to the University Librarian, Perkins Library, Duke University, Durham, N. C. 27706.

Laboratories

The laboratories in the various science departments (Botany, Chemistry, Physics, Psychology, and Zoology) are designed for both teaching and research. Ideal locations for special work in some of the sciences are available at Duke University Marine Laboratory at Beaufort, North Carolina; at Highlands Biological Laboratory at Highlands, North Carolina; in the Duke Forest at Durham, North Carolina; and in the Sarah P. Duke Gardens on the West Campus of Duke University.



Student Life



Living Accommodations

Duke University provides residence hall accommodations on West Campus for graduate and undergraduate students enrolled in the summer session. Efforts are made to house all students in air-conditioned facilities, but because these are limited, use of non-air-conditioned buildings may become necessary.

Air-conditioned apartments are available for single students and married students accompanied by their families. Units in the new Central Campus Apartments and Town House Apartments will be used.

Information for each type of residential accommodation may be obtained by writing the appropriate manager whose address is found on page 22 in the chapter on Financial Information.

Dining Service. Food service is cafeteria style. The cost of meals runs from $2.50 to $3.00 per day, depending on the needs and tastes of the individual. Only the dining facilities on the West Campus will be used for the regular summer session students. The cafeteria in the Men's Graduate Center is usually not open in the summer.

Duke University Marine Laboratory. The Duke University Marine Laboratory, located on Pivers Islands, has cottage-type residence halls which will be available for summer session students. Further information may be obtained from the *Bulletin of the Duke University Marine Laboratory.*

Services Available

Medical Care. The Student Health Service, located in the Marshall I. Pickens Rehabilitation Center, operates during the summer session and, except for hospitalization in the University infirmary, offers the same medical and surgical services available to full-time students during the academic year as described in the *Bulletin of Information and Regulations.* Use of the Student Health Service is restricted to matriculating students. Presentation of a current student identification card is required.

The Student Mental Health Service is located in the Pickens Rehabilitation Building on Erwin Road. The service provides evaluation, brief counseling, and treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Student Mental Health Service records are maintained separately and are not a part of any other record system, academic or medical. Contact with the service is strictly confidential. No illness is treated in dormitories or other student residence rooms.

Regular clinic services are available for use from 8 a.m. to 6 p.m. Monday through Saturday and from 2 p.m. to 8 p.m. Sunday at the University Health Clinic, Pickens Building, West Campus, Duke extension 6721.

The University Counseling Center. The University maintains a University Counseling Center which provides a centralized program of educational, vocational, and personal counseling for students. This confidential counseling service on problems of personal, social, educational, and vocational adjustment is provided without cost to students enrolled at the University. In addition, the center administers special group testing programs for University schools and departments and serves as the local testing center for a wide variety of national testing programs. The center also carries on programs of research in the field of measurement and counseling. Although the counseling, testing, and research services of the center are designed primarily to meet the needs of the students, faculty, and staff of Duke University, these services are made available to individuals and organizations outside the University as its facilities permit. Requests for further information should be addressed to the Director, University Counseling Center, 309 Flowers, Duke University, Durham, North Carolina 27706.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to students in the summer session who are registered for a degree at Duke University. The staff is available to talk with summer session students about their professional plans and with school officials who may be seeking the services of new teachers. Students who are eligible to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated during the time the student is enrolled at Duke. Copies of academic records are released only with the permission of the individual.

Part-time employment listings for the campus and Durham area are maintained in the office. All students interested in working during the summer session should register at the beginning of the term. Every effort will be made to help each student find a job consistent with his interests.

Student Activities

Religious Life. During the summer the Duke Chapel is open every day for prayer and meditation from 9:00 a.m. to 8:00 p.m. The Sunday morning worship in the Chapel at 11:00 a.m. is the central focus for the summer ministry. The University ministers and chaplains are available for assisting in planning programs and projects and for discussions and personal counseling.

Recreation and Activities. The summer session will provide a varied program of entertainment and recreation. The program includes movies, dances,



and open house socials. Tours to areas of interest can be arranged for weekends. Both the mountains and the seashore are easily accessible. Adequate facilities are available for those interested in swimming, tennis, and other sports. Clubs organized for the summer play an active part in all social activities and recreation.

Summer Theater at Duke. For its fourth season, the Summer Theater at Duke will offer four major productions and four "Midnight Specials" during a season which will run from May 30 to July 20. There will be a discount on admission prices for Duke students. Production schedules and season ticket information may be obtained at Page Box Office.

Interested students are invited to join the company or crew of Summer Theater at Duke. For further information on productions and auditions, write to Professor John Clum, Box 4941, Duke Station, Durham, N. C. 27706.

Publications

During the summer the University will publish each session *The Duke University Calendar,* an official calendar announcing events—academic, social, and recreational—of the following term. This calendar also includes official notices concerning academic requirements. Students are expected therefore to read the *Calendar* regularly.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or as are, from time to time, put into effect by the appropriate authorities of the University. The student is expected to be familiar with the current *Bulletin of Information and Regulations* as well as any published regulations for the summer session.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University. University authorities will take action in accordance with academic due process.



Admission



Qualifications for Admission

Students in the following categories may be admitted to the Duke University Summer Session:

1. Graduates and undergraduates who are presently enrolled and in good standing in Duke University.
2. Graduates and undergraduates who have been formally admitted or readmitted to Duke University.
3. Students who are currently in good standing at their respective institutions and who have approval by the proper authority to take and transfer credits earned in the Duke Summer Session.
4. Teachers in service with or without the bachelor's degree who wish to earn credits for certification purposes.

Admission to specific courses offered in the summer session is governed by the student's academic status (freshman, sophomore, junior, senior, graduate, special, or unclassified) and by the prerequisites of the course in question. All applicants are considered without regard to race, color, religion, sex, or national origin.

Application Procedures

Duke Students in Residence during the Spring Semester, 1975. A Duke University student, either graduate or undergraduate, who plans to attend the summer session should at the time of preregistration for the fall semester (see page 71 for specific dates) enroll for the desired summer session courses. He need not file with the Summer Session Office the application blank at the end of this *Bulletin*.



Undergraduates Not in Residence at Duke during the Spring Semester, 1975. New students seeking to enter Duke University as freshmen or as undergraduates with advanced standing, and undergraduates who wish to reenter the University, should write the Office of Admissions requesting application forms.

Undergraduates, both men and women, enrolled in other colleges and universities who desire to earn in the Duke University Summer Session credits which are to be transferred to their own institutions should apply directly to the Director of the Summer Session, Duke University, on the application form at the end of this *Bulletin*. They should give accurately and clearly all information called for on the application form.

Graduates Not in Residence at Duke during the Spring Semester, 1975. Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this *Bulletin*. Those who are seeking admission to the Graduate School *must also file* Graduate School application forms which may be secured by writing to the Dean of the Graduate Schoo!, Duke University, Durham, North Carolina 27706.

Students who have graduate standing, who are currently employed as teachers, and who wish to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 4 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application at the end of this *Bulletin* may be used.

Postdoctoral Scholars. Application for these postdoctoral research privileges must be made in advance by letter to the Director of the Summer Session giving the applicant's present position, the specific field of his research interest, and the dates during which he desires to be in residence. Approved applicants will be accepted subject to the availability of library and dormitory space.







Admission to Degree Candidacy

Undergraduates. A student seeking to enroll as a candidate for the bachelor's degree from a college or school of Duke University must meet the entrance requirements set forth in the *Bulletin of Undergraduate Instruction* and be accepted by the Director of Admissions, Duke University. This *Bulletin* may be secured by writing the Office of Admissions, Duke University.

Graduates. A student seeking to enroll as a candidate for one of the advanced degrees offered by the Graduate School of Duke University must meet the requirements set forth in the *Bulletin of the Graduate School.* This *Bulletin* may be secured by writing to the Office of the Graduate School, Duke University.



Financial Information



Tuition and Fees

The University Tuition. The following charges will cover registration and medical care:

1. Tuition for undergraduates—$231 for each non-laboratory course, $308 for each undergraduate laboratory course, and $462 for each one and one-half course program offered at the Marine Laboratory.
2. Tuition for graduate students—$77 per unit; for an undergraduate course, the tuition rate is as indicated in paragraph 1 above.
3. Teachers in full-time service in elementary and secondary schools, except teachers pursuing a doctoral program at Duke—one-half of the tuition charges specified in paragraphs 1 and 2 above.
4. All students pursuing a doctoral program (post-master's) at Duke—fees as specified in paragraphs 1 and 2.

Laboratory Fees. For Marine Laboratory investigators' research table fee, see the *Marine Laboratory Bulletin.*

Medical Mycology Fee. This fee of $200 replaces the University tuition.

Master's Degree Summer Session Tuition. A master's candidate who submits his thesis when not registered for at least 1 unit of research-residence tuition is required to pay the 1-unit tuition of $77.

Auditing Fees. These fees are as follows:

1. Students registered for a full course program may audit non-laboratory courses (with the permission of the Director) at no extra charge.
2. Students carrying less than a full course program may be granted permission to audit a course but they will pay half the University fee for the course.

Late Registration Fee. Students who fail to register prior to the first class day of a given course will pay an extra charge of $10.

Fee for Course Changes. Course changes other than those required by the University will be made only on payment of an extra fee of $1 per change.

Fee for Make-up Final Examination. This fee is $5.

Refund for Tuition and Fees. Tuition and fees will be refunded under the following circumstances:

1. When applications for withdrawal are received by the Director of the Summer Session before the first class day of a given term of the summer session, full tuition and fees will be refunded.
2. When applications for withdrawal are received by the Director of the Summer Session during the first four class days of a given term, 80 percent of the tuition and fees will be refunded.
3. When applications for withdrawal are received by the Director of the Summer Session after the fourth class day, there will be no refund of tuition and fees.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Living Accommodations

Rates for Residence Hall Space for Each Summer Term*

	All courses except science and Medical Mycology	*Science and Medical Mycology*
Single occupancy	$125	$107
Double occupancy	$ 93	$ 80

*Rates for non-air-conditioned space when used will be somewhat lower.

Rates for one, two, or three-bedroom apartments vary according to the type unit desired and the number of persons occupying the apartment. Linen rental service is available through the Student Laundry on West Campus. No housewares are available for use in apartments.

For detailed information on types of accommodations available at Duke University for the summer session write: (For Residence Halls), Manager of Residence Halls, Department of Housing Management, Duke University Durham, N. C. 27706; (For Apartments), Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, N. C. 27706.

Estimated Cost of One Term of the Summer Session

University tuition, two non-laboratory courses or 6 graduate units	$462.00*
Residence Hall Fees (double room for one term)	93.00
Meals (cafeteria selective; average per day $3.00)	90.00†
Books and class materials (average)	20.00†
Miscellaneous (laundry, etc.)	20.00†
Total	$685.00

*Teachers, elementary and secondary, in full-time service (except teachers pursuing a doctoral program at Duke) pay $231.

†Approximate costs will vary according to individual tastes and needs.

Student Aid

Special Tuition Rate to Teachers. Teachers in full-time service in elementary and secondary schools, except those who are pursuing a doctoral program at Duke, pay only one-half of the regular tuition charge. Teachers on leave of absence from their schools and teachers not currently employed are not eligible for this special fee.

Scholarships for Public School Personnel. Duke University will offer twenty-two special scholarships of $231 each to high school and elementary teachers on a competitive basis (not by a written examination) for the summer session of 1975. This scholarship program is intended to encourage teachers to begin or to continue their graduate studies leading to the A.M., M.Ed., or M.A.T. degree.

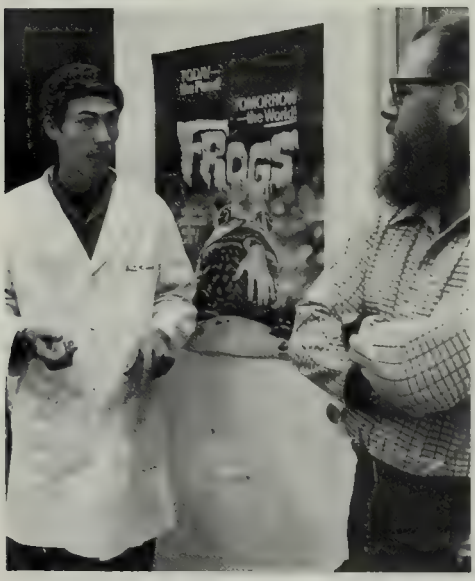
Duke University will again offer five special scholarships of $240 each to high school and elementary administrators and supervisors. This scholarship program is intended to encourage principals and supervisors to continue their graduate studies leading to advanced degrees.

Although successful applicants for the scholarships will not be required to become candidates for a degree, they must qualify for and receive admission to the Graduate School.

All applications with supporting documents must be submitted by April 1, 1975. Selection and appointment of scholars will be completed by May 1, 1975.









Application blanks and complete information may be obtained from the Director of the Summer Session, Duke University, Durham, North Carolina 27706.

Loans. A number of loan funds have been established for the benefit of students of Duke University. Several of these funds are available to students enrolled in the summer session. Students enrolled in the summer session *only* are not eligible. These funds are administered through a committee of officers of the University.

The committee, in approving loans, selects those students who, from the standpoint of character, scholastic attainment, and degree of financial need, are deserving of consideration.

Applicants for loans should make application to the Manager, Student Loan Office, Duke University. All applications must be initiated during the first week of each term. The granting or withholding of a loan is a matter entirely within the discretion of the Student Loan Committee. A student is expected to use all other possible means of securing financial assistance before applying for aid from a loan fund.



National Direct Student Loan Program. A limited number of loans may be made, under the provisions of the Education Amendments of 1972, to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session *only* is not eligible for consideration. Students pursuing the M.A.T. Cooperative Program are not eligible. Inquiries concerning opportunities available under this program should be made to the Manager, Student Loan Office, Duke University, Durham, North Carolina 27706.

Duke University Federally Insured Loan Program. Under this program, students are allowed to borrow up to $2,500 per year at 7 percent interest rate. An interest subsidy is available from federal funds for all students who have demonstrated need on the Parents' Confidential Statement. As under the National Direct Student Loan Program, loans can be made to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session *only* is not eligible for consideration. Inquiries concerning opportunities available under this program should be made to the Manager, Student Loan Office, Duke University, Durham, North Carolina 27706.

Remission of Tuition. Children of Methodist ministers who are members of the North Carolina and Western North Carolina Conferences of the United Methodist Church are entitled to a remission of the tuition charge. This consideration is given only to the children of resident members of the two North Carolina conferences who are giving their full time to religious work. Only those students enrolled in a regular undergraduate program leading to a baccalaureate degree from the University are entitled to this benefit. Students in this group are entitled to a maximum of eight semesters of free tuition at the undergraduate level. Application for this benefit should be made to the Director of Undergraduate Financial Aid, Duke University, Durham, N. C. 27706.

Tuition Grants. Tuition grants are available to children of faculty and qualified staff members of Duke University. Information regarding the tuition grant program may be obtained by writing to the Director of Undergraduate Financial Aid, Duke University.



Registration and Regulations



Definition of Terms

Registration. A student has completed registration for the summer session when:

1. His course program has been written and approved by the dean of the school or college in which he is enrolled or by the Director of the Summer Session in the case of the special or unclassified student.
2. Summer session forms have been completed properly by the student in the Summer Session Office.
3. Summer session University fees have been paid. A place in a course cannot be assured until fees have been paid. Tuition bills are not sent to the student's home.

Pre-Enrollment. The term *pre-enrollment* refers only to the writing of the course program and its approval by the proper authority or by the Director of the Summer Session in the case of the special or unclassified student. Pre-enrollment alone does not constitute registration.

General Registration

In the 1975 summer session, classes in Term I will begin on Tuesday, May 13; in Term II on Monday, June 16; and in Term III on Friday, July 18. A student attending Term I or Term II of the 1975 summer session must complete his registration in the Summer Session Office, 116 Allen, on or before the Friday preceding the first class day of the given term: Term I, Friday, May 9; Term II, Friday, June 13. Students attending Term III must complete their registration in the Summer Session Office on or before Wednesday, July 16.

A student in classes beginning on dates other than the beginning date of each of the three terms must complete his registration in the Summer Session Office before the date on which those classes begin.

Late Registration

Any student who fails to register on or before the dates specified in the preceding paragraphs will be charged a fee of $10 for late registration. All late registrations and course changes must be completed by the end of the third class day of each term (May 15, Term I; June 18, Term II; and July 21, Term III). All course changes must be approved by the dean of the school or college in which the student is enrolled, or, in the case of the special or unclassified student, by the Director of the Summer Session.

Since summer session courses present a program of study in more concentrated and rapid form than in the regular semesters, students are advised to register on time and to be present at all class sessions.

Advanced Registration

Students in Residence during the Spring Semester, 1975. Graduate and undergraduate students in residence at Duke University during the spring semester, 1975, who plan to enroll for courses or research in one or more terms of the 1975 summer session will write course programs and have them approved in their respective schools or college during the week of preregistration, March 31-April 3, 1975.

Graduate and undergraduate students in residence, whose course programs have been written and approved by their respective schools or college on the date indicated above, may complete their registration in the Summer Session Office, 116 Allen Building, by paying their tuition from May 1 to May 9.

A Duke student, graduate or undergraduate, who desires to attend the summer session but did not preregister on March 31 to April 3 should complete his registration by the Friday preceding the beginning of the term he wishes to attend.

Students Not in Residence at Duke during the Spring Semester, 1975. Students not in residence at Duke University during the spring semester, 1975—new undergraduate students seeking to enter as degree candidates, graduate students who are not candidates for an advanced degree at Duke University, graduate and undergraduate students of other colleges and universities desiring to earn credits for transfer, public school teachers, and college teachers (not advanced degree candidates)—may register by mail. Advance registration by mail includes:

1. Completion in full of the application form at the end of this *Bulletin*.
2. Admission to the summer session by the Director of the Summer Session and, in case of a student seeking to enter Duke University as a degree candidate, admission by the admissions director to the school or college of Duke University concerned.
3. Completion in full and return of forms required by the Summer Session Office at least one week prior to the beginning of the term involved.
4. Payment of tuition by at least 1 week prior to the beginning of classes.

Students who have not completed their registration by mail for courses in Terms I and II should complete their registration in the Summer Session Office, 116 Allen Building, on the Friday previous to the first class day in Terms I and II. For Term III the student must complete his registration in the Summer Session Office on Wednesday, July 16.

Degree-Candidate Graduate Students Not in Residence during the Spring Semester, 1975. A graduate student not in residence during the spring semes-







ter, 1975, who is a candidate for an advanced degree in the Graduate School of Duke University, may complete his registration by mail if his director of graduate studies and the Graduate School Office approve the registration. The student will follow the same four steps given above. Any graduate student unable to complete registration by mail must present himself for registration in the Summer Session Office on May 9 for Term I, June 13 for Term II, and July 16 for Term III.

Registration of Graduate Students. Graduate students in residence during the spring semester will preregister for one or more terms of the summer session on March 31 through April 3. Newly admitted graduate students who have not completed their registration by mail should present themselves for registration at the official registration periods. All graduate students are required to register both with the Summer Session Office and with the Graduate School Office.

Graduate students resident in the spring semester who intend to remain in residence during one or more of the three summer session terms without registering for course work or at least 1 unit of research must register for 1 unit to cover the cost of medical care and the use of University facilities. These units of registration will entitle students to use the Student Health Service and University facilities during the three terms of the summer session. The master's candidate who has completed all requirements except submission of the thesis and who so registers is not charged any separate fee for submitting the thesis, but he is required to register for 1 unit.

Graduates Not in Residence at Duke during the Spring Semester, 1975. Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this *Bulletin*. Those who are seeking admission to the Graduate School must also file Graduate School application forms which may be secured by writing to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706.

Students with graduate standing and currently employed as teachers who wish only to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 4 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application form at the end of this *Bulletin* may be used.

Academic Regulations

Types of Course Enrollment. Summer session courses may be taken for credit or may be audited. A student's program may be exclusively in one of these categories, or may combine the two of them. Students taking a full or partial program for credit may enroll as auditors in any number of additional courses.

The summer session term *credit* does not mean degree credit at Duke University unless the student has been admitted as a degree candidate by one of the colleges or schools of the University. A student taking a course for credit is expected to do all the work required and to take the final examination, and he will receive a grade. G.I. Bill benefits are available only to those veterans who enroll for credit.

An auditor is entitled to listen to lectures and class discussions, but he may not participate in discussions or take examinations. A student carrying a full progam for credit may be given permission to audit as many courses as he desires without additional fees. Students carrying less than a full program for credit may secure permission to audit but are required to pay the auditing fee, which is half the regular fee.

Credits. The summer session courses are of the same quality and credit values as courses in the regular semester. Credit earned in the summer session is in terms of courses or units. The majority of summer session courses carry one course to 3 graduate units of credit and require one term in residence.

A student desiring either graduate or undergraduate credits transferred from Duke University to his university or college as degree credit must request from the Director of the Summer Session, Duke University, a Course Approval Form to be completed by the student's dean or registrar and returned to the Director of the Summer Session.

Under certain circumstances a maximum credit of 6 units in a master's degree program may be allowed for graduate courses completed elsewhere. Approval for the transfer of credits will not be given until the student has spent one semester or two terms in residence. The acceptance of credit up to this amount will not reduce the minimum period of full-time registered residence at Duke University. In no case will credit be allowed for extension or correspondence courses.

With the approval of both the student's major department and the Dean



of the Graduate School, a student who is granted such transfer of credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units. Or he may be permitted to fill out his schedule with as much as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level.

For regulations concerning the application of graduate credit earned elsewhere to a graduate program here, consult the *Bulletin of the Graduate School*. See page 7 for information concerning reciprocal agreement with the University of North Carolina.

Professional credits toward teacher's certificates are granted by the various state boards of education, each in accordance with its own carefully planned rules. Teachers in service, before enrolling for certification credit, should consult the rules laid down by their State Board of Education. If necessary, they should send to their State Board of Education a list of the courses in which they plan to enroll and inquire whether these will be acceptable for certification credit.

Maximum Course Program. The maximum program for one term of the summer session is two courses.

Dropping of Courses. During the first three days of classes in any term, a student may add or drop a course with the permission of the instructor. Thereafter, no course may be added. A course may be dropped without penalty, however, until the end of the second week of each term with the permission of an academic dean. (The permission of the Director of the Summer Session is required for students from other universities or colleges.) Courses dropped after the second week are ordinarily assigned an *F* grade, as are courses dropped without permission.

Grading. Only a student taking a course for credit will receive a grade. The grade given represents the quality of the work done in the course.

Passed. The following are passing grades for undergraduates and graduates:

Undergraduate Grades	Graduate Grades
A—exceptional	*E*—exceptional
B—superior	*G*—good
C—satisfactory	*S*—satisfactory
D—low pass	

Failed. A grade of *F* indicates that the student has failed the course. In order to receive credit for the course he must repeat the work in class.

Pass/fail Option. With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one elective, non-major course each summer. In addition, with the consent of the instructor, adviser, and director of undergraduate studies a student may take for pass/fail credit courses in independent study or internship in any department including that of his major. Certain internships and small group experiences will be offered only on a pass/fail basis.

A student enrolling in a course on a pass/fail basis completes all the work of the course but receives either a pass (*P*) or fail (*U*) grade in lieu of a standard grade. After the first three days of classes in any term, no student may change his status to or from a pass/fail basis. A pass grade may not subsequently be converted to a regular letter grade nor may the course be retaken on a regular credit basis.

For the effect of the election of the pass/fail option in determining honors, consult the *Bulletin of Undergraduate Instruction.*

Incomplete. A grade of *I* may be reported by the instructor if for any reason he is unable to report the final grade at the regular time. Incomplete courses must be completed before the close of the succeeding semester; otherwise the *I* is recorded as *F*, and the course must be repeated in class if the student is to receive credit for it.

Absent from Final Examination. The grade of *X* indicates that the student was absent from the regularly scheduled examination. A student absent from examination, if the absence has been excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, may receive an examination upon the payment of $5 to the Bursar of the University. The instructor concerned arranges for the examination in cases where absences are excused. A student with an *X* grade who has not obtained a passing grade before the end of the semester following that in which the *X* was incurred is regarded as having failed in the course concerned and must repeat the work in class in order to receive credit. If a student's absence from an examination is not excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, his grade for the course concerned is recorded as *F*.

Examinations. Final examinations in courses are held on the last two days of each term. Final examinations for short courses will be held on the last day of the course. The examination dates for the first term are June 13, 14; second term July 16, 17; and third term August 18, 19.

Courses in science for the first term have been scheduled so that their final examination will come on June 13. The science courses which begin on June 16 and run for four weeks will have their final examination on July 11. The University has no provision for giving examinations *in absentia*. Students



absent from examinations for valid reasons are permitted a liberal extension of time to return to the University for the completion of credit.

Continuation Requirements. A student must achieve a satisfactory record of performance during the summer session in order to maintain his enrollment at Duke. Students regularly enrolled in Trinity College of Arts and Sciences who fail more than one course in a summer term or in a summer session will be excluded from the College. Where continuation from the summer session into the fall semester is in question, incomplete work in any course is considered failure to achieve a satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the first day of classes for the fall semester. No student who has incomplete course work from *both* the spring semester and the summer session may continue into the fall semester.

A student from another university or college may be dismissed by the Director of the Summer Session for failure to exhibit satisfactory performance.

Withdrawal from the Summer Session. If a student wishes to withdraw from the summer session, he must notify both the dean of the school or college in which he is registered and the Director of the Summer Session.

Motor Vehicle Regulation

Students enrolled in the summer session must register their motor vehicles with the Traffic Office, 2010 Campus Drive, West Campus.

To register a vehicle, the student must present the following documents: (1) state vehicle registration certificate, (2) valid driver's license, and (3) satisfactory evidence of automobile liability insurance as required by North Carolina law—$10,000 per person, $20,000 per accident for personal injuries, and $5,000 property damage. A small parking fee will be charged.

Parking, traffic, and safety regulations will be given each student who registers his vehicle. Students are expected to abide by these regulations.



Courses of Instruction



Course Enrollment

Eligibility. Courses numbered 1-49 are primarily for freshmen, or freshmen and sophomores. Courses numbered 50-99 are ordinarily for sophomores, or sophomores and juniors. Courses numbered 100-199 are designed for juniors and seniors. Courses numbered 200-299 are planned for seniors and graduates. Courses numbered 300 up admit graduate students only. Courses numbered from 200 up are limited in enrollment to 25 students.

Minimum Enrollment Required. All courses are offered subject to minimum enrollments. The University reserves the right to withdraw undergraduate courses in which fewer than twelve students enroll, senior-graduate courses numbered 200-299 in which fewer than ten students enroll, and graduate courses and seminars numbered 300 or above in which fewer than six students enroll. In withdrawing a course, the University attempts to avoid undue hardships on students. Sometimes, therefore, courses are offered in spite of small enrollments. Courses not listed will be given when a demand develops and an instructor is available.

Departmental Officials and Regulations

Departments offering summer session programs are listed alphabetically. Under each department is given the name of the chairman, of the director of graduate studies, and of the director of undergraduate studies. Where departments have set up special regulations for admission to candidacy for the master's degree, these are included.

Summer Session Schedule of Classes

Summer session classes will meet Monday through Friday each week, and on Saturday, June 21 and Saturday, July 12 during Term II; and on Saturday,

July 19 and Saturday, August 16 during Term III. The other Saturdays during each term are available for conferences or class work.

Class periods are as follows:

First period:	8:00 a.m. to 9:20 a.m.
Second period:	9:40 a.m. to 11:00 a.m.
Third period:	11:20 a.m. to 12:40 p.m.
Fourth period:	1:20 p.m. to 2:40 p.m.

The meeting place for a course is indicated immediately after the class period for the course. Building designations are as follows:

East Campus
A—West Duke
B—Carr
C—Science
F—Bivins

West Campus
3—Gray
4—Perkins Library
5—Foreign Languages
9—Psychology-Sociology
10—Social Sciences
47—Engineering
49—Physics
53—Allen
58—Biological Sciences
65—Gross Chemistry
CG—Card Gym

Anatomy

Professor Robertson, *Chairman* (465 Sands Building, West Campus); Assistant Professor Adelman, *Director of Graduate Studies* (270 Sands Building, West Campus)

First Term

151. Anatomy of the Lower Extremities as it Relates to Locomotion. Dissection of the human adult lower extremity. Demonstration and discussion of gait, biomechanics, and kinesiology. One course. *Bassett.* 9:40-11:00.

312. Research. Individual investigations in various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff.*

340. Tutorial in Advanced Anatomy. (Consult *Graduate School Bulletin* for description.) *Staff.*

354. Research Techniques in Anatomy. (Consult *Graduate School Bulletin* for description.) *Staff.*

Second Term

208. Anatomy of the Trunk. Designed for Ph.D. degree candidates in anatomy as well as practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisites: core course in anatomy and permission of instructor. Number of students arranged by staff. 2 units. *Duke.*

312. Research. Individual investigations in the various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff.*

Third Term

312. Research. Individual investigations in the various fields of anatomy.

(Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff.*

Anthropology

Professor Friedl, *Chairman and Director of Graduate Studies* (344 Sociology-Psychology Building); Associate Professor Apte, *Director of Undergraduate Studies* (337 Sociology-Psychology Building)

First Term

119. Language, Culture, and Society. Analysis of language behavior within and across societies relating variations in linguistic usage to sociocultural factors: ethnosemantics, social dialects, ethnography of speech, language standardization, multilingualism, language loyalties, problems of lingua franca, language planning and policies in developing nations. Prerequisite: Anthropology 107 or permission of the instructor. One course. *Apte.* 11:20-12:40. 9.126.

129. Peoples of the World: Middle East. Emphasis on language, kinship, economics, politics, and religion. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Rosen.* 9:40-11:00. 9.127.

251. Ethnography of Humor. Examination of theoretical framework, research methods and data-collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Apte.* 8:00-9:20. 9.126.

Second Term

93. Human Origins. Origins and distribution of mankind; primate evolution; a survey of human paleontology and human biology, prehistory and language; and the origins of human social organization and culture. One course. *Beecher.* 9:40-11:00. 9.127.

94. Elements of Cultural Anthropology. The dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. Primarily meant for students not majoring in the social sciences. One course. *Fox.* 8:00-9:20. 9.144.

280S. Ethnicity and Acculturation. The role of ethnic social organization and ethnic symbols in industrial societies. Emphasis on primitive, peasant, and industrial societies, and on immigrants and ethnic enclaves within Canada and the United States. One course. *Fox.* 11:20-12:40. 9.144.

Third Term

94. Elements of Cultural Anthropology. The dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. Primarily meant for students not majoring in the social sciences. One course. *R. Hamilton.* 8:00-9:20. 9.133.

118. Child Language Acquisition. Major theoretical positions in linguistic theory and their application to child language data; universals of child language acquisition; the acquisition of phonology, syntax, and semantics in English and other languages. Data analysis included. One course. *R. Hamilton.* 11:20-12:40. 9.133.

Art

Professor Jenkins, *Acting Chairman* (203 Art Building, East Campus); Assistant Professor Pratt, *Director of Undergraduate Studies* (101T West Duke Building, East Campus)

First Term

53. Beginning Studio. Introduction to two-dimensional design with emphasis on a directed approach to figure drawing. One course. *S. Pratt.* 10:00-12:40. A.106. (Enrollment limited to 18.)

54. Beginning Studio. Continuing introduction to two-dimensional design with emphasis on exploring theoretical and intuitive concepts in design in black and white and color, directed toward painting. Prerequisite or corequisite: Art 53. One course. *S. Pratt.* 1:20-4:00. A.106.

153. Painting. Studio practice in painting with individual and group criticism and discussion of important historic and contemporary ideas in painting. Prerequisite: Art 53-54, or equivalent, or consent of the instructor. One course. *V. Pratt.* 1:20-4:00. A.101.

155. Advanced Drawing and Color. Studio practice in a variety of drawing media, with discussion and criticism emphasizing individual direction and development. Prerequisite: Art 53-54 or equivalent, or consent of the instructor. One course. *V. Pratt.* 10:00-12:40. B.215.

161. Sculpture. Sculpting in clay, plaster, and wax in order to produce a metal sculpture by the lost wax process. Each student will be expected to carry one piece to completion. Prerequisite: Art 53-54 or equivalent, and consent of the instructor. One course. *Smullin.* 8:20-11:00. 1044 W. Forest Hill Blvd.

171. Advanced Sculpture. Sculpting by the lost wax process. For students with a year of experience in sculpture. Students will be expected to prepare three pieces for casting. Prerequisite: Art 161-162 or equivalent, and consent of the instructor. One course. *Smullin.* 8:20-11:00. 1044 W. Forest Hills Blvd.

173. Advanced Painting. Prerequisites: Art 153 and 154, or equivalent. One course. *V. Pratt.* 1:20-4:00. A.101T.

Studio fees. A fee of $40 will be charged to cover the cost of models and supplies for each course.

Asian and African Languages

First Term

161. Modern Japanese Fiction in Translation. Readings of twentieth century Japanese novels and short stories. One course. *Rolf.* 11:20-12:40. B.107.

Biochemistry

Professor Hill, *Chairman* (255 Medical Sciences I); Professor Rajagopalan, *Director of Graduate Studies* (235B Medical Sciences I)

First Term (Durham Campus)

208. Laboratory Methods in Biochemistry. An advanced laboratory course that emphasizes current procedures, instrumentation, and experiments. Each student selects from a number of experiments of a wide range of classical

investigations that illustrate significant biochemical progress. Hours to be arranged. One course (3 graduate units). *Staff.*

Second Term (Duke Marine Laboratory, Beaufort)

276. Comparative and Evolutionary Biochemistry. (Also Zoology 276.) Lectures and discussions of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. Two courses (6 graduate units). *Sullivan.*

Biology*

Third Term

14. Principles of Biology. A one-semester introduction open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. One course. *Staff.* 9:40-11:00. Laboratory, 2:00-5:00 Monday through Thursday. Lecture, 58.130; Laboratory, 58.115.

Black Studies Program

Professor Burford, *Director* (314 Carr Building, East Campus)

First Term

150. Third World Literature. Selected works with special emphasis upon Black American, African, and Caribbean writers. One course. *Burford.* 1:20-2:40. 9.144.

176. Marxism, and Black Liberation. Marxist perspective on the liberation of Black America. One course. *Olela.* 9:40-11:00. 9.144.

Third Term

99. Dimension of Racism. The nature of racism, its inter-connection with aspects and institutions of American life and its effects. One course. *Staff.* 9:40-11:00. 9.144.

Botany

Professor Wilbur, *Chairman* (147 Biological Sciences); Associate Professor Searles, *Director of Graduate Studies* (257 Biological Sciences); Professor White, *Director of Undergraduate Studies* (371 Biological Sciences)

Students admitted to candidacy for an advanced degree in botany should have completed a minimum of 12 semester hours of courses in botany (or biology) beyond an elementary course, and related work in biological sciences. Students who have not yet had the minimum hours, however, may enter higher courses by permission of the instructor, if he is convinced that they can carry the work for undergraduate credit, and may count such work toward hours necessary for candidacy.

*See other courses listed under Botany and Zoology.

First Term (Durham Campus)

103. General Bacteriology. A study of the morphology and fundamental physiological processes of bacteria: their relationship to sanitation, public health, soil fertility, and food preservation. Prerequisite: introductory biology. One laboratory course. *Johnson.* 1:00-5:00. 58.256.

152. Plant Identification. Practice in the identification of local plants and a study of the principles underlying plant classification. Laboratory, lectures, and field trips. One laboratory course. *Wilbur.* 8:00-12:00. 58.154.

242. Systematics. A general survey of the principles of vascular plant taxonomy, with practice in identification and collection. Lectures, laboratories, and field trips. Prerequisite: one year of biology. One laboratory course (4 graduate units). *Wilbur.* 8:00-12:00. 58.154.

226. Special Problems. Hours to be arranged. *Staff*

360. Research. Hours to be arranged. *Staff.*

First Term (Duke Marine Laboratory, Beaufort)

225. Special Problems. Hours to be arranged. *Staff.*

359. Research. Hours to be arranged. *Staff.*

Second Term (Durham Campus)

156. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisite: introductory biology. One laboratory course. *Christensen.* 8:00-12:00. 58.144.

246. Ecology. Intensive study of the environmental effects on growth and distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. One laboratory course (4 graduate units). *Christensen.* 8:00-12:00. 58.144.

Second Term (Duke Marine Laboratory, Beaufort)

202. Phytoplankton Systematics. Taxonomy and classification of marine phytoplankton; general characteristics, phytogeography, life histories, and study techniques. Individual projects. One and one-half courses (6 graduate units). *Blankley.*

225. Special Problems. Hours to be arranged. *Staff.*

359. Research. Hours to be arranged. *Staff.*

Third Term (Durham Campus)

155. Plant Anatomy. A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or permission of the instructor. One laboratory course. *White.* 8:00-12:00. 58.361.

205. Anatomy. Intensive survey of vascular plant cell types, tissues, and organs, with emphasis on the modern application of anatomy to problems of systematics and phylogeny. Laboratories will include microtechnique. Special

project and term paper stressing current techniques and literature required. Prerequisite: permission of instructor. One laboratory course (4 graduate units). *White.* 8:00-12:00. 58.361.

Third Term (Duke Marine Laboratory, Beaufort)

204. Marine Microbiology. The major groups of marine microorganisms: bacteria, fungi, protozoa, and phytoplankton—their taxonomy, culture, physiology, and ecology. Field and laboratory work with observational and experimental methods on the dynamics of marine microorganisms. Prerequisite: a course in general biological science or botany. One and one-half courses (6 graduate units). *Cavaliere.*

211. Marine Phycology. An introduction to marine algae; their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. One and one-half courses (6 graduate units). *Searles.*

225. Special Problems. Hours to be arranged. *Staff.*

359. Research. Hours to be arranged. *Staff.*

Chemistry

Professor Quin, *Chairman* (101 Paul M. Gross Chemical Laboratory); Professor Chesnut, *Director of Graduate Studies* (330 Paul M. Gross Chemical Laboratory); Professor Wells, *Director of Undergraduate Studies* (333 Paul M. Gross Chemical Laboratory)

All classes in chemistry, Term I, will begin on May 19 and continue through June 14. Classes in Term II will begin June 16 and continue through July 11. Classes in Term III will begin on July 18 and continue through August 19.

First Term

11. Principles of Chemistry. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Emphasizes stoichiometry and atomic and molecular structure. Laboratory work includes both qualitative and quantitative analysis. Prerequisites: one year of high school chemistry and qualification for Mathematics 31. One laboratory course. *Wells.* Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Laboratory, 65.211; lecture and recitation, 65.107.

151. Organic Chemistry. The structures and reactions of the compounds of carbon. Laboratory experiments illustrate the techniques of separation and structure determination. Prerequisite: Chemistry 12 or its equivalent. One laboratory course. *Wilder.* Lecture daily, 9:30-11:30; laboratory Monday through Thursday, 12:30-4:30. Laboratory, 65.224; lecture, 65.107.

161. Physical Chemistry. Fundamentals of theoretical chemistry illustrated by selected laboratory experiments. Prerequisites: Chemistry 152, Physics 51, 52, and Mathematics 32. One laboratory course. *Smith.* Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Laboratory, 65.229; lecture and recitation, 65.110.

375. Thesis Research. Research in the fields of physical, analytical, inorganic, or organic chemistry. Open to those students whose research programs for the M.A. and Ph.D. degrees have been approved by the department

and by one of the instructors in charge of the course. Schedule to be arranged. (Not more than 1 unit of credit per week for full-time schedule or 1 unit each two weeks for half-time schedule.) 2 to 8 units. Available during Terms I, II, and III.

Second Term

12. Principles of Chemistry. Continuation of Chemistry 11. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Prerequisite: Chemistry 11 or its equivalent. One laboratory course. *Palmer.* Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Lecture and recitation, 65.111; laboratory, 65.103.

152. Organic Chemistry. A continuation of Chemistry 151. The structures and reactions of the compounds of carbon. Laboratory experiments illustrate organic reactions and preparations. Prerequisite: Chemistry 151. One laboratory course. *Jeffs.* Lecture daily, 9:30-11:30; laboratory Monday through Thursday, 12:30-4:30. Lecture, 65.103; laboratory, 65.224.

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 161, 162 or equivalent); statistics (Mathematics 183, or equivalent), or permission of the instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. One and one-half lab courses (6 graduate units). *Baier.*

Third Term

230. Chemical Pollution of Coastal Waters. Sources and sinks for chemical pollutants and impact on coastal biomes. Laboratory and field experiments to illustrate problems in verifying the extent of chemical pollution. Analysis of exemplary chemical plants to derive plans for pollution control. Prerequisites: Chemistry 161 and 162 or equivalent; Chemistry 132 or equivalent; and calculus, or permission of the instructor. (Given at Beaufort.) One and one-half courses (6 graduate units). *Baier.*

Classical Studies

Professor Oates, *Chairman* (325 Carr Building, East Campus); Assistant Professor Rigsby, *Director of Undergraduate Studies* (327 Carr Building, East Campus)

CLASSICAL STUDIES

First Term

54. Roman History. The Roman republic and empire to the Council of Nicaea. (Also listed as History 54.) One course. *Oates.* 9:40-11:00. 5.219.

114. Greek Drama. Reading in English translation of Aeschylus, Sophocles, Euripides, Aristophanes, and Menander. (Not open to students who have taken Classical Studies 51.) One course. *Oates.* 11:20-12:40. 5.219.

GREEK

First Term

181S. Greek Seminar. An intensive introduction to the language and

literature. Open only to students who have achieved proficiency in another language. Two courses. *Staff.* 8:00-9:20. B.206.

191. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff.*

LATIN

First Term

181S. Latin Seminar. An intensive introduction to the language and literature. Open only to students who have achieved proficiency in another language. Two courses. *Staff.* 9:40-11:00. B.206.

191. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff.*

GREEK

Second Term

182S. Greek Seminar. Continuation of Greek 181S. Two courses. *Staff.* 8:00-9:20. B.206.

192. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff.*

LATIN

Second Term

182S. Latin Seminar. Continuation of Latin 181S. Two courses. *Staff.* 9:40-11:00. B.206.

192. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff.*

Comparative Literature

Professor Salinger, *Chairman of the Committee on Comparative Literature* (106 Languages)

Second Term

152. Andre Gide: The Art of Fiction and Autobiography. (Also listed as French 152.) One course. *Fowlie.* 8:00-9:20. 5.014.

191. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. *Salinger.*

193. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. *Salinger.*

205. Foundations of Twentieth Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lagerkvist, Camus, Gide, and Hesse) evolving toward a mythology of man. One course (3 graduate units). *Salinger.* 11:20-12:40. 5.109.

Computer Science

Professor Loveland, *Chairman* (407 Computation Center); Associate Professor Patrick, *Director of Graduate Studies* (408 Computation Center)

First Term

51. Introduction to Digital Computation. Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming, and least-squares techniques. One course. *Patrick.* 8:00-9:20. 49.113.

Second Term

150. Computers and Programming. Computer structure, machine language, instruction execution, addressing techniques, and digital representation of data. Computer systems organization, logic design, micro-programming, and interpreters. Symbolic coding and assembly systems, macro definition and generation, and program segmentation and linkage. Prerequisites: Computer Science 51. One course. *Staff.* 9:40-11:00. 10.119.

251. Computer Science for Teachers. An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. One course (3 graduate units). *D. Smith.* 1:30-2:50. 49.124.

Divinity School

Professor Thomas A. Langford, *Dean* (107B New Divinity School); Associate Professor James M. Efird, *Director of Academic Affairs* (101C New Divinity School)

First Term

N. T. 103. Hellenistic Greek. Designed for beginners to enable them to read the Greek New Testament. 3 graduate units. *Efird.* 9:40-11:00. New Divinity School. 011.

399. Also by special arrangement with an instructor a student may arrange for independent study in a given area of specialized research.

Drama

Assistant Professor Clum, *Chairman* (502 Allen Building)

First Term

101. Acting. Basic acting skills; movement, improvisation, interpretation. One course. *Staff.* 1:30-3:00. 10.139. (See also English 120 and Classical Studies 114.)

Second Term

105. Educational Theater. Training for teachers and future teachers in producing and directing junior high and high school productions; play selection, casting, publicity, ticket sales, basic directing. (See also English 181S.) *Clum and Staff.* 1:30-3:00. 10.139.

Persons interested in theater are encouraged to participate in the work of Summer Theater at Duke, the summer producing wing of the Drama Program. See Professor Clum for details.

Economics

Professor Kelley, *Chairman* (215 Social Sciences); Associate Professor Wein-

traub, *Director of Graduate Studies* (315 Social Sciences); Assistant Professor Black, *Director of Undergraduate Studies* (233 Social Sciences)

First Term

51. National Income and Public Policy. Basic economic analysis emphasizing current public policy issues. How the level and rate of growth of aggregate national income and output are determined. What causes unemployment, inflation, and international payments problems. How monetary policy (money supply and interest rates) and fiscal policy (government expenditures and taxes) affect these problems. One course. *Black.* 8:00-9:20. 10.227.

53. Economics of Contemporary Issues. Modern economic problems, such as environmental deterioration and urban decay, viewed in context of the market which is in turn viewed as one of the interrelated subsystems of the social system and examined from institutionalist, Marxist, and other perspectives in the social sciences. One course. *Havrilesky.* 9:40-11:00. 10.227.

153. Monetary Economics. The evolution and operations of commercial and central banking and non-bank financial institutions in the United States, the determination of monetary aggregates and interest rates, the financial impacts of Treasury operations, and linkages from Federal Reserve actions to price level, employment, economic growth, and balance of payments objectives. One course. *Yohe.* 9:40-11:00. 10.136.

154. Aggregative Economics. Concepts and measurement of national income and expenditures, employment, interest rates and price levels; the theoretical determination of these aggregates; applications of macroeconomic theory to business cycles and economic growth. One course. *Bronfenbrenner.* 11:20-12:40. 10.227.

318. Dissertation Seminar. 3 units. *Weintraub.*

Second Term

52. Competition, Monopoly, and Welfare. (See Economics 2.) For sophomores, juniors, and seniors. Not open to students who have had Management Sciences 50. One course. *Vernon.* 8:00-9:20. 10.227.

108. Economics of War. Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex, disarmament and the economy. Prerequisite: Economics 52. One course. *Weintraub.* 11:20-12:40. 10.232.

138. Economic Statistics. Survey of principal concepts and methods; application to economics. (Not open to students who have had Mathematics 53 or 183, Management Sciences 110, Psychology 117.) One course. *Wyse.* 11:20-12:40. 10.227.

149. Microeconomic Theory. Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. (Not open to students who have had either Economics 161 or Public Policy Studies 110.) *Graham.* 9:40-11:00. 10.220.

Education

Professor Flowers, *Chairman* (213I West Duke Building, East Campus); Professor Petty, *Director of Graduate Studies* (205 West Duke Building and 116 Allen Building); Associate Professor Colver, *Director of Undergraduate Studies* (205 West Duke Building, East Campus)

Duke University is accredited by the National Council of Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel, with the doctoral degree as the highest degree approved.

It is the intention of the department to make available to degree candidates all courses ordinarily required for certification as graduate teachers, counselors, principals, and superintendents. These courses will normally be offered at least once every three years.

First Term

100. Social and Philosophical Foundations of Education. A study of the basic features, assumptions, viewpoints, and issues of education in contemporary America. This course or Education 113 is required of all who intend to practice teach and of all majors in education and should be taken in the junior year. One course. *Di Bona.* 9:40-11:00. 53.225.

Second Term

206. Studies in the History of Educational Philosophy. The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. One course (3 graduate units). *Carbone.* 8:00-9:20. A.204.

213. Elementary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the elementary school staff. The scope of elementary education is considered to encompass nursery school, kindergarten, and the elementary school. Special treatment is given to the problems of internal organization and management of the elementary school, and its integration with the secondary-school level. One course (3 graduate units). *Pittillo.* 8:00-9:20. A.212.

224. Teaching the Social Studies in Elementary Schools. One course (3 graduate units). *Cartwright.* 1:30-2:50. A.204.

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course (3 graduate units). *Cartwright.* 1:30-2:50. A.204.

233. Improvement of Instruction in English. Recent developments and research techniques in the teaching of English with individual projects. Prerequisite: permission of instructor. One course (3 graduate units). *Shuman.* 11:20-12:40. A.212.

239. The Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School. Recent development in the teaching of grammar, composition, mechanics, and usage. Students will write and grade compositions. Term project. One course (3 graduate units). *Shuman.* 1:30-2:50. A.202.

243. Personality Dynamics. A study of personality structure and dynamics with emphasis upon the implications for counseling and instruction. Prerequisite: six hours of psychology or educational psychology. One course (3 graduate units). *S. Gehman.* 8:00-9:20. A.202.

246. The Teaching of Mathematics. This course deals with such topics as aims, curriculum, course and lesson planning, and classroom procedure for teaching secondary school mathematics. One course (3 graduate units). *Swain.* 1:30-2:50. 49.124.

249. Exceptional Children. A survey of the major categories of excep-

tional children, mental retardation, emotional disturbance, brain injured, learning disabilities, physically handicapped, visual and auditory deficits, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment will be discussed. One course (3 graduate units). *Davis.* 11:20-12:40. A.202.

250, 251. Teaching Emotionally Disturbed Children: Internship. Basic principles and practices in teaching and the organization of instructional materials. Work with children under the supervision of a certified teacher of emotionally disturbed children. Experience in general classroom teaching and small group and individualized instruction. Participation in staff conferences involving psychiatrists, psychologists, social case workers, and professional educators. One course (3 graduate units) each. *S. Gehman.* Hours to be arranged.

253. Introduction to Law and Education. Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. One course (3 graduate units). *Martin.* 11:20-12:40. 4.027.

259. Problems in Law and Education. Concentration on current issues and to researching of cases, constitutional decisions, and statutes. Prerequisite: Education 253 or permission of the instructor. One course (3 graduate units). *Martin.* 9:40-11:00. 4.027.

276. The Teaching of High School Science. Discussion, lectures, and collateral reading relating to such topics as aims, tests, curriculum, classroom, and laboratory procedure; field trips; and course and lesson planning for secondary-school science. One course (3 graduate units). *Githens.* 1:30-3:30. A.103.

303. Diagnostic and Educational Programs in Learning Disabilities. Diagnostic, intervention, and remediation strategies and program development for the child with learning disabilities; review of major works in this field. Prerequisite: permission of the instructor. 3 graduate units. *Davis.* 9:40-11:00. A.202.

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 units. *Carbone.* 11:20-12:40. Rogers-Herr Junior High School.

323. Public School Finance. A study of educational costs, sources of revenue, basis of distribution, and accounting for funds spent. 3 units. *Pittillo.* 9:40-11:00. A.212.

326. Educational Psychology: The Problem Child. Study of problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. 3 units. *I. Gehman.* 9:40-11:00. A.204.

Third Term

217. The Psychological Principles of Education. An advanced study of teaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. One course (3 graduate units). *Weitz.* 9:40-11:00. A.202.

221. Programs in Early Childhood Education. Examination of the objectives and philosophy underlying programs in early childhood education, including an overview of existing practices, research findings, and experimental projects dealing with social, emotional, physical, and cognitive development. One course (3 graduate units). *Fulbright.* 8:00-9:20. 53.225.

226. Teaching Developmental and Remedial Reading in the Elementary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. One course (3 graduate units). *Adams.* 9:40-11:00. 53.233.

234. Secondary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the secondary school staff. The scope of secondary education is considered to encompass junior high school, regular high school, senior high, and junior college. Special treatment is given to the problems of internal organization and management. One course (3 graduate units). *Flowers.* 8:00-9:20. 53.226.

236. Teaching Developmental and Remedial Reading in the Secondary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. For secondary school teachers of all subjects who wish to improve the reading and study habits of their students. One course (3 graduate units). *Adams.* 11:20-12:40. 53.233.

256. Classroom Assessment of Student Achievement. The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. One course (3 graduate units). *Colver.* 11:20-12:40. A.202.

260. Introduction to Educational Research. Research methodologies: experimental, historical, survey, philosophic, and case study. Fundamentals of statistical inference, research design, and computer applications to research problems. One course (3 graduate units). *Troy.* 8:00-9:20. A.202.

272. Teaching Communication Skills in Early Childhood Education. An examination of the development of communication skills from birth to age eight with emphasis on reading readiness and language growth. One course (3 graduate units). *Fulbright.* 11:20-12:40. 53.225.

332. Supervision of Instruction. A study of the nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 graduate units. *Hurlburt.* 9:40-11:00. A.212.

Engineering

Professor Vesić, *Dean of the School of Engineering* (136 Engineering Building); Assistant Professor George, *Assistant Dean* (136 Engineering Building)

First Term

197-198. Projects in Civil Engineering. These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: permission of the instructor and the Director of Undergraduate Studies. Each, half-course or one course. *Staff.*

155.* Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and the instructor. Each, half-course or one course. *Staff.*

173.* Projects in Electrical Engineering. A course which may be undertaken only by seniors who are enrolled in the Graduation with Distinction program, or who show special aptitude for individual project work. Elective for electrical engineering majors. Prerequisite: consent of the Director of Undergraduate Studies. Half-course to two courses. *Staff.*

265.* Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. One course. *Staff.*

399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 graduate units. *Graduate Staff.*

165.* Special Topics in Mechanical Engineering and Materials Science.

198.* Projects in Mechanical Engineering and Materials Science.

265.* Advanced Topics in Mechanical Engineering and Materials Science.

399.* Special Readings in Mechanical Engineering and Materials Science.

Second Term

31. Computers in Engineering. Introduction to the use of digital computers in engineering. Attributes of digital computer systems; program languages, flow charts; numerical analysis, including approximation and interpolation, searches and maximazation, linear equations, application to engineering; introduction to decision processes in engineering, including linear programming, optimization network methods; punched card operation; graphical output. Not open to students who have completed Computer Science 51 or M.E. 31. One course. *Utku.* 9:40-11:00. 47.216.

197-198. Projects in Civil Engineering. (See description as given under First Term.)

English

Professor Budd, *Chairman* (325 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Professor Williams, *Director of Undergraduate Studies* (402 Allen Building)

Candidates for the master's degree in English are expected to have had at least 18 units in undergraduate courses above the sophomore level. The department may also require additional courses if the work of the student in his first term indicated inadequate preparation.

First Term

21S. Studies in the Novel. A study of the major forms of the novel, with particular emphasis on narrative techniques employed by nineteenth and twentieth century novelists. One course. *Mellown.* 11:20-12:40. 4.230.

*This course will be offered Terms II and III also.

55. Representative British Writers. Chaucer's Prologue to *The Canterbury Tales* and at least two tales, Shakespeare's *I Henry IV*, *Hamlet* or *King Lear*, and one other play, John Donne's poetry (selections), and Milton's *Paradise Lost* (selections) and some of the shorter poems. One course. *Ferguson.* 9:40-11:00. 53.326.

107. Introduction to Linguistics. Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. Prerequisite: sophomore standing. (Also listed as Anthropology 107.) One course. *Butters.* 8:00-9:20. 53.327.

120. Stagecraft. An introductory course on the technical aspects of play production: scene design and construction, lighting, properties, make-up and costuming. Laboratory work will be coordinated with the various productions of Summer Theater at Duke. One course to be continued into Term II. Both terms must be taken for full credit. Mondays and Wednesdays: 3:30-5:00. Fred Theater. *Parker.*

153. Twentieth Century Poetry. A study of twentieth century poetry and criticism of poetry in England and America. Problems in critical analysis and interpretation. Emphasis on sources in nineteenth century Symbolism and on the poetry of Hopkins, Yeats, Eliot, Pound, and Stevens. One course. *Mellown.* 8:00-9:20. 53.326.

183S. Conference on Fiction. Studies in novels from the eighteenth, nineteenth, and twentieth centuries on the theme of the individual versus society. One course. *Ferguson.* 11:20-12:40. 53.328.

268. American Literature, 1865-1915. Selected works of representative authors: Crane, Norris, Dreiser, Edith Wharton, O'Neill, Robinson, and Frost. One course (3 graduate units). *Budd.* 9:40-11:00. 53.327.

Second Term

56. Representative British Writers. Novels by Fielding *(Joseph Andrews)*, Dickens *(Great Expectations)*, and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. One course. *Smith.* 9:40-11:00. 53.327.

120. Stagecraft. Continued from Term I. *Parker.*

124. Shakespeare. About ten plays after 1600. One course. *Jones.* 11:20-12:40. 53.327.

181S. Conference on Drama. Modern Dramatic Literature. An investigation of major plays and playwrights of the past twenty-five years, including plays in the repertory of Summer Theater at Duke. The focus will be on the many approaches to dramatic form and the actor-audience relationship demonstrated by modern playwrights and directors. One course. *Reardon.* 8:00-9:20. 53.328.

184S. Conference on Folklore. A study of the varieties of oral tradition, represented by myth, folktale, legend, and ballad; the methods of the folklorist; the function of folklore and its relation to literary tradition. One course. *Nygard.* 9:40-11:00. 53.328.

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course (3 graduate units). *Nygard.* 8:00-9:20 53.327.

252. English Literature of the Twentieth Century. Representative work of

leading writers from 1900 to 1950, in fiction, drama, and poetry: Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. One course (3 graduate units.) *Smith.* 11:20-12:40. 53.326.

263. American Literature, 1800-1865. The writers emphasized are Emerson, Thoreau, and Hawthorne. One course (3 graduate units). *Jones.* 9:40-11:00. 53.326.

Third Term

56. Representative British Writers. Novels by Fielding (*Joseph Andrews*), Dickens (*Great Expectations*), and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. One course. *Monsman.* 9:40-11:00. 53.327.

176. American Literature since 1915. Poetry, fiction, drama, and critical prose from Stein, Anderson, O'Neill, Hemingway, and Faulkner to such contemporary authors as Malamud and R. Lowell. One course. *Duffey.* 8:00-9:20. 53.327.

184S. Conference on Mythology and Literature. Study of the literary use of myth and legend. Emphasis will be on classical mythology, especially as found in Hesiod and Ovid, and on the reinterpretation of these stories by medieval and modern authors, culminating in John Updike's *The Centaur* and John Barth's *Chimera.* Also, particular stories like that of Leda and the Swan will be traced throughout literature from antiquity to the present day. One course. *Reiss.* 11:20-12:40. 53.328.

208. History of the English Language. Introductory survey of the changes in sounds, forms, and vocabulary of the English language from its beginnings to the present; with emphasis on the evolution of the language as a medium of literary expression. One course (3 graduate units). *Reiss.* 1:30-2:50. 53.327.

246. English Literature of the Later Nineteenth Century. Devoted chiefly to Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. One course (3 graduate units). *Monsman.* 11:20-12:40. 53.327.

275. American Literature since 1915. Selected fiction, from Gertrude Stein to the present. One course (3 graduate units). *Duffey.* 9:40-11:00. 53.326.

285. Literary Criticism. A study of the Greek and Roman critics, in chronological order but with emphasis on their permanent value rather than on the history; also of the Renaissance and Neoclassic Continental and English critics. One course (3 graduate units). *Jackson.* 8:00-9:20. 53.326.

Forestry

Professor Ralston, *Dean of the School of Forestry and Environmental Studies* (213 Biological Sciences Building, West Campus); Professor Anderson, *Director of Graduate Studies* (04 Biological Sciences Building, West Campus)

The requirements for the degree of Master of Forestry (M.F.) are governed by the extent of the student's previous undergraduate education and by his specific career objectives. Students with no prior preparation in forestry are required to begin their studies with a summer term of eight weeks.

Qualified students may engage in thesis research in certain branches of forestry during the summer session with the approval of the instructor concerned and the Dean of the School of Forestry and Environmental Studies, or of the Director of Graduate Studies in the case of work taken through the Graduate School.

Second Term

200. Careers in Natural Resources. A weekly seminar which surveys the research and managerial career opportunities in all fields of renewable natural resources. Required of students in Academic-Forestry program. No credit. (Also continued through Term III.) *Staff.*

205. Tree Growth and Development. Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. *Barnes.*

241. Dendrology. Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisite: Biology 1-2 or equivalent. 3 units. *White.*

357. Research in Forestry. Open to students whose research programs for the M.F. or D.F. degree have been approved by the Dean of the School of Forestry and Environmental Studies and the instructor responsible for directing the research.

Third Term

256. Forest Measurements. Application of plane-surveying techniques to the measurement of land area, topography, and timber type; measurement of volume and growth of forest trees and stands; measurement of forest products. 4 units. *White.*

289. Interpretation of Aerial Photographs. Principles of aerial photography and remote sensing as applied to forest administration, vegetation mapping, forest mensuration, and insect and disease surveys. 2 units. *Chaiken.*

Geology

Professor Heron, *Chairman* (118 Science Building, East Campus); Associate Professor Perkins, *Director of Graduate Studies* (111 Science Building, East Campus); Associate Professor Furbish, *Director of Undergraduate Studies* (104 Science Building, East Campus)

First Term (Durham Campus)

3. Environmental Geology. Earth processes including geologic hazards; earth materials, including mineral resources, as related to man. Not open to those who have completed Geology 1. One course. *Heron.* 11:20-12:40. C.116.

Second Term (Duke Marine Laboratory, Beaufort)

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distributions, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (This course is not open to students who have completed Geology 206.) One and one-half courses (6 graduate units). *Pilkey.*

German

Professor Borchardt, *Acting Chairman* (102 Language Building); Assistant Professor Stern, *Director of Graduate Studies* (105 Language Building); Associate Professor Novak, *Director of Undergraduate Studies* (111 Language Building)

The work in German 1, 2, and 63 will be coordinated with listening and oral practice in the language laboratory which students in German classes will be privileged to attend.

First Term

1. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. One laboratory course. *Stern.* 11:20-12:40 and Tuesdays and Fridays 2:00-3:20. 5.109.

63. Intermediate German. Grammar review and composition; reading of short stories, novels, and poems. Prerequisite: German 1-2 or two units of high school German. One laboratory course. *Novak.* 9:40-11:00 and Mondays and Thursdays, 2:00-3:20. 5.109.

103S. Seminar in German Literature in English Translation. Topics to be specified. One course. *Bessent.* 9:40-11:00. 5.08.

117. German Conversation and Composition. Primarily conversation with practice in writing. For German majors and other students by permission of instructor. One course. *Bessent.* 8:00-9:20. 5.08.

191. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission of the department. One course. *Staff.*

Graduate Reading Course. An intensive study course in German to develop rapidly the ability to read technical German in several fields. For graduate students only. No degree credit. *Novak.* 8:00-9:20. 5.109.

Second Term

2. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Prerequisite: German 1 or equivalent. One laboratory course. *Stern.* 11:20-12:40 and Tuesdays and Fridays, 2:00-3:20. 5.08.

104S. Seminar in German Literature in English Translation. One course. *Alt.* 9:40-11:00. 5.08.

118. German Conversation. A course primarily in speaking German with some practice in writing. One course. *Alt.* 8:00-9:20. 5.08.

192. Independent Study. Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. *Staff.* Hours to be arranged.

194. Independent Study. Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. *Staff.* Hours to be arranged.

YIDDISH

First Term

181. Elementary Yiddish. A thorough study of elementary Yiddish grammar with readings, composition, and oral practice. No prerequisites. One laboratory course. *Alt.* 11:20-12:40. 5.015.

Health Administration

Professor Jaeger, *Chairman* (262 Baker House); Assistant Professor Smith, *Director of Graduate Studies* (234B Baker House)

All courses extend throughout the summer session and are closed to students in departments other than Health Administration.

324. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; planning function; and the evaluation of performance. 4 credits. *Staff.*

326. Health Economics. A study of the current state of knowledge with regard to the economics of health and medical care. Attention is given to the unique problems of demand and supply in the health services sector, as well as the implications of private and public financing alternatives; restrictions on man-power entry. Incentives and mobility; and problems of productivity measurement and changes. 2 credits. *Staff.*

Health and Physical Education (Men)*

Professor Friedrich, *Chairman* (105 Card Gym); Associate Professor Skinner, *Director of Undergraduate Studies* (106 Card Gym)

First Term

120. Beginning Swimming. Basic fundamentals and strokes of swimming are taught. One-fourth course. To be arranged. *Persons.* Gym.

125. Swimming and Life Saving. In this course students may complete requirements to obtain Red Cross Life Saving Certificate. One-fourth course. To be arranged. *Persons.* Gym.

130 Golf. Basic fundamentals and shots in golf are taught. Students use practice driving range and putting green as well as Duke Golf Course. One-fourth course. To be arranged. *Myers.*

140. Tennis. Primary emphasis is on tennis strokes, fundamentals, and game strategy. One-fourth course. To be arranged. *LeBar.*

171. Recreational Leadership. Theories and philosophies of play and recreation with emphasis on leadership techniques with program administration and application to community organizations, school, and government sponsored programs. One course. *Friedrich. 9:40-11:00. Gym.*

172. The Administration of Health, Physical Education, and Athletics in Secondary Schools. One course. *Friedrich.* 11:20-12:40. Gym.

173. Protective Practices in Physical Education and Athletics. Training and conditioning of athletic teams and the prevention, diagnosis, and treatment of athletic injuries. One course. *Riebel and Ritz.* 8:00-9:20. Gym.

Second Term

120. Beginning Swimming. Basic fundamentals and strokes of swimming are taught. One-fourth course. To be arranged. *Persons.* Gym.

125. Swimming and Life Saving. In this course students may complete re-

*All courses open to both men and women.

quirements to obtain Red Cross Life Saving Certificate. One-fourth course. To be arranged. *Persons.* Gym.

163. Athletic Coaching in Secondary Schools. (Track and Baseball.) Emphasis is given to the fundamentals and theory of coaching track and baseball. One course. *Buehler.* 9:40-11:00. Gym.

173. Protective Practices in Physical Education and Athletics. Training and conditioning of athletic teams and the prevention, diagnosis, and treatment of athletic injuries. One course. *Riebel and Ritz.* 8:00-9:20. Gym.

Health and Physical Education (Women)*

Professor Bookhout, *Chairman* (101 East Campus Gym); Associate Professor Spangler, *Director of Undergraduate Studies* (206 East Campus Gym)

First Term

61.1. Beginning Tennis. Introduction to and development of basic skills in forehand, backhand, and serve. One-fourth course. *Raynor.* 8:00-9:20. West Tennis Courts.

61.2. Intermediate Tennis. Development of basic skills in forehand, backhand, serve, and game situations. One-fourth course. *Raynor.* 11:20-12:40. West Tennis Courts.

History

Professor Durden, *Chairman* (235 Allen Building); Professor A. Scott, *Director of Graduate Studies* (237 Allen Building); Professor Hollyday, *Director of Undergraduate Studies* (227 Allen Building)

First Term

21. Europe to the Eighteenth Century. Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Hollyday.* 8:00-9:00. 53.225.

54. Roman History. (Listed also as Classical Studies 54.) One course. *Oates.* 9:40-11:00. 5.219.

91. The Development of American Democracy to 1865. A study of the trends vital to an understanding of the United States today with attention to foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals. One course. *Lindley.* 9:40-11:00. 53.226.

139. Europe in the Era of National Unification. Clash of nationalities, conflict between monarchic conservatism and liberalism, romanticism and realism in literature and art with emphasis on change in Central Europe from Metternich to 1871. One course. *Hollyday.* 9:40-11:00. 53.229.

162. History of Modern Russia. An exploration into the processes of social change. One course. *Miller.* 11:20-12:40. 53.233.

201. Aspects of Change in Prerevolutionary Russia. Origins and dynamics of the Russian revolutionary movement and the role of the intelligentsia. One course (3 graduate units). *Miller.* 9:40-11:00. 53.233.

*All courses open to both men and women.

Second Term

22. Europe from the Eighteenth Century. Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Mauskopf.* 8:00-9:20. 53.225.

92. The Development of American Democracy, 1865 to the Present. Emphasis upon the emergence of contemporary problems. One course. *Gifford.* 8:00-9:20. 53.226.

158. Science and Society, 1700-1900. Major scientific achievements and their social settings. One course. *Mauskopf.* 9:40-11:00. 53.225.

229. Recent Interpretations of Modern European History. Analysis and discussion of key historical problems from the Renaissance to the present. One course (3 graduate units). *Gunsburg.* 8:00-9:20. 53.234.

240. Aspects of Traditional and Modern African Culture. Introduction to oral and written literatures and musical and artistic traditions. One course (3 graduate units). *Hartwig.* Open only to students participating in the Intercultural Education Project. To be arranged.

250. Social and Intellectual History of the United States, 1865 to the Present. One course (3 graduate units). *Gifford.* 11:20-12:40. 53.234.

263. American Colonial History, 1607-1763. An interdisciplinary study of early American culture and society with emphasis on representative cultural movements. One course (3 graduate units). *Fulcher.* 9:40-11:00. 53.234.

Third Term

173. History of Spain and the Spanish Empire, 1450-1715. Unification and development of Spain under Ferdinand and Isabella, Charles I, and Phillip II; the Spanish conquest of the New World and development of colonial institutions and culture. One course. *TePaske.* 9:40-11:00. 53.229.

232. Modern Spain, 1715-1974. Bourbon reforms, the Napoleonic Wars, fall of the Spanish American Empire, development of modern Spain through the Franco Regime. One course (3 graduate units). *TePaske.* 8:00-9:20. 53.234.

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation with special emphasis on social and economic change. One course (3 graduate units). *Calkins.* 11:20-12:40. 53.234.

277. The Coming of the Civil War in the United States, 1820-1861. One course (3 graduate units). *Durden.* 9:40-11:00. 53.234.

Management Sciences

Professor Keller, *Chairman* (114 Social Sciences Building); Professor Dickens, *Director of Undergraduate Studies* (203 Social Sciences Building)

First Term

50. Elementary Theory of Economic Enterprise. Analysis of the internal resource allocation problem of the enterprise, of market structures, and the relationship between the two. Topics include marginal analysis, theories of competitive market structures, and introduction to special problems of finance, marketing, and production. Prerequisite or corequisite: Math. 32. One course. *Staff.* 8:00-9:20. 10.231.

55. Quantitative Analysis for Management. Some mathematical theory and techniques used in the study of economic enterprise, such as classical optimization, optimization under constraints, introductory matrix and linear algebra, basic probability theory, special probability distributions. Not open to students who have had Economics 134, Mathematics 103, or Mathematics 135. Prerequisite: Math. 31. One course. *Staff.* 11:20-12:40. 10.231.

100. Introduction to Financial Accounting. Conceptual framework of external reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economic terms and the interpretation of published financial statements. Prerequisite: sophomore standing. One course. *Staff.* 9:40-11:00. 10.231.

231S. Financial Accounting. An in-depth analysis of the requirements of outsiders (investors, auditors, unions, and governments) for information about the status and operations of firms and a framework for disclosure of the relevant data. Prerequisites: Management Sciences 120, 130, and 140, or permission of instructor. One course (4 units). *Staff.* 8:30-10:10. 10.232.

233S. Federal Income Taxation. A study of the principles of federal income tax laws as related to corporations and individuals. Tax planning and the effect of tax law on business decisions will be emphasized. Prerequisite or corequisite: M.S. 231 or permission of instructor. One course (4 units). *Staff.* 10:30-12:10. 10.232.

312. Operations Research. Deterministic and probabilistic models useful in the analysis of management problems, with particular emphasis on model formulation, information requirements, model validation, sensitivity analysis, and utilization of model outputs in problem-solving. Topics include: mathematical programming, decision-making under uncertainty, and digital simulation. One course (4 units). *Staff.* (312.1 MSM students only. Mon. and Thurs., May 13-August 19. 5:00-6:40. 10.231.); (312.2 MHA students only. 8:30-10:10. 10.229.)

330. Accounting and Control Systems. The concept of the master budget is used to establish a basis for quantifying the planning activities of the firm and for developing a financial feedback and control system for internal management and control. After a brief introduction to and review of basic data accumulation systems, the topics for study include budgeting, standard costs and variance analysis, capital budgeting and activity analysis. One course (4 units). *Staff.* MSM students only. Mon. and Thurs., May 13-August 19. 7:20-9:00 p.m. 10.229.

Second Term

110. Statistics for Management Decisions. Fundamentals of classical and Bayesian statistical analysis and elementary decision theory. Application of statistical analysis to decision problems. Topics include a review of sampling distributions, point and interval estimation, hypothesis testing, decision theory, and regression and correlation analysis (including computer routines). Not open to students who have had Management Sciences 60, Economics 138, or Mathematics 136. Prerequisite: Management Sciences 55, Mathematics 135, or Economics 54. One course. *Staff.* 11:20-12:40. 10.231.

130. Information Systems. An analysis of the data needed for economic decisions relating to business enterprises and of the systems used in accumulating, analyzing, interpreting, and presenting the data to various users. Financial reporting to external users and managerial use of information for decision-making are stressed. Prerequisite: Management Sciences 50, 55, or equivalent. One course. *Staff.* 9:40-11:00. 10.231.

232S. Internal Control and Auditing. An analysis of the accounting control system and the independent auditor's examination of that system and other evidence as a basis for expressing an opinion on a client's financial statements. Topics include basic audit objectives, standards, ethics, terminology, procedures, and reports. Prerequisites: Management Sciences 110 and 231, or permission of instructor. One course (4 units). *Staff.* 8:30-10:10. 10.232.

234. Advanced Financial Accounting. Accounting for and reporting on the diverse activity of multi-product, multi-divisional, multi-national organizations. Organizations with and without profit goals are studied. Prerequisite: MS 231. One course (4 units). *Staff.* 10:30-12:10. 10.229.

349a. Cooperative-Competitive Relations and Decisions. A simultaneous treatment of the organization's decisions on its cooperative and competitive behavior, and on the design of its internal structure and its operations. The subject of the course is the organization's coordinated treatment of the decision variables which reflect its direct relations to the economic units with which it cooperates and competes to effect exchange transactions, and those which relate to the form of its internal operations and organizational structures. 2 credits. *Staff.* 8:30-9:20. For MHA students only. 10.229.

349b. Short and Long-Run Planning. An integrated treatment of the functional areas of the firm in the context of short-run and long-run decisions problems. Topics include: forecasting, cash management, budgeting, investment decisions in plant, equipment and product, choice of technology, cost of capital, taxes, etc. 3 credits. *Staff.* 9:40-11:00. MHA students only. 10.227.

Third Term (July 21-August 29)

308. Calculus for Management. An introductory treatment of calculus for graduate students in Management. *Zalkind.* Mon., Tues., and Thurs. 5:00-6:40. Problem session 7:20-9:00. 10.231.

Mathematics

Professor Warner, *Chairman* (135C Physics Building); Professor Weisfeld, *Director of Graduate Studies* (230 Physics Building); Professor Murray, *Director of Undergraduate Studies* (135A Physics Building)

First Term

31. Introductory Calculus. Limits, differentiation, and integration with applications to physical problems. Prerequisite: three years of college preparatory mathematics. One course. *Staff.* 11:20-12:40. 49.120.

53. Basic Statistics. Principal statistical methods including application to psychological, economic, business administration, and educational problems. Techniques of data collection and presentation, hypothesis testing, using the chi-square, ti, and F distributions, interval estimation and linear regression. Not open to students who have had Economics 138 or Psychology 117. One course. *Burdick.* 9:40-11:00. 49.132.

Second Term

19. Pre-Calculus Mathematics. Selected topics in algebra, trigonometry, and analytic geometry. Students with CEEB achievement scores in mathematics below 530 need this skill course before taking Mathematics 31. Prerequisite: two years of college preparatory mathematics. One course. *Staff.* 8:00-9:20. 49.132.

31. Introductory Calculus. Limits, differentiation, and integration with applications to physical problems. Prerequisite: three years of college preparatory mathematics. One course. *MacKichan.* 9:40-11:00. 49.132.

32. Introductory Calculus. Transcendental functions, sequences, series, Taylor's formula. Prerequisite: Math. 31. One course. *D. Smith.* 11:20-12:40. 49.132.

216. Intermediate Analysis. Series; uniform convergence, integration. Theory of functions of a real variable. One course (3 graduate units). *Warner.* 8:00-9:20. 49.124.

220. Advanced Linear Algebra with Applications. Solutions of systems of linear inequalities; applications to linear programming and game theory; computation of eigenvalues and eigenvectors. One course (3 graduate units). *Weisfeld.* 9:40-11:00. 49.124.

Third Term

19. Pre-Calculus Mathematics. Selected topics in algebra, trigonometry, and analytic geometry. Students with CEEB achievement scores in mathematics below 530 need this skill course before taking Mathematics 31. Prerequisite: two units of college preparatory mathematics. One course. *Moore.* 9:40-11:00. 49.124.

32. Introductory Calculus. Transcendental functions, sequences, series, Taylor's formula. Prerequisite: Math. 31. One course. *Staff.* 11:20-12:40. 49.124.

226. Theory of Numbers. Divisibility; congruences, Chinese Remainder Theorem; arithmetic functions. One course (3 graduate units). *Kraines.* 9:40-11:00. 49.128.

271. Introductory Topology. Set theory, metric spaces, topological spaces; separation axioms; connectedness; continuity; paracompactness. One course (3 graduate units). *Hodel.* 11:20-12:40. 49.128.

Microbiology and Immunology

Professor Joklik, *Chairman* (Research Park IV); Professor Willett, *Director of Graduate Studies* (111 Research Park IV)

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

First Term

212. Research Techniques in Microbiology and Immunology. An introduction to biochemical, immunological, and cell culture techniques with emphasis on approaches to contemporary problems in molecular and cellular biology. Prerequisites: Biochemistry 247 or equivalent, and permission of instructor. Offered only in the summer. 1 unit. *Dawson, Vanaman, and Staff.* Hours to be arranged.

213. Research Techniques in Microbiology and Immunology. Continuation

of 212. 1 unit. *Dawson, Vanaman, and Staff.* Open only to graduate students in Microbiology and Immunology.

Second Term

325(B). Medical Mycology. Comprehensive lecture and laboratory coverage of all the fungi pathogenic for humans. Practical aspects as well as future trends in the mycology, immunology, diagnosis, pathogenesis, and epidemiology of each mycotic agent will be explored. There will be several invited lecturers, each an internationally recognized scientist, discussing their particular areas of mycological expertise and current research. Prerequisite: permission of instructor. Enrollment limited to 20. July 7-August 1. *Dr. Mitchell.* 8:30-12:00 Noon, Monday-Friday. Lecture: M-312 Davison; Laboratory: M-310B Davison.

Music

Associate Professor Tirro, *Chairman* (105C Biddle Music Building); Professor Hanks, *Director of Undergraduate Studies* (075 Biddle Music Building)

First Term

125. Masterworks of Music Literature. An intensive study of selected masterworks which represent the principal currents in modern music history. Compositions by Bach, Mozart, Beethoven, Brahms, Debussy, and Bartok will constitute a frame of reference for historical, biographical, and stylistic analysis. One course. *Henry.* 8:00-9:20. 53.234.

174. Introduction to Jazz. A multidisciplinary survey for non-majors which examines musical, aesthetic, sociological, and historical aspects of jazz. One course. *Coker.* 9:40-11:00. 53.234.

Second Term

65. Fundamentals of Music Theory. Physical properties of sound; principles of diatonic tonal organization; melodic and harmonic constructions; elementary counterpoint and figured base. Skill course. Prerequisite: basic knowledge of musical notation and vocabulary. One course. *Maves.* 8:00-9:20. 53.318.

181, 182. Independent Study in Musical Performance. Intensive coaching and performance in chamber music at Kneisel Hall, Blue Hill, Maine. See Music Department for dates and fees. Two courses. *Mueller.*

Nursing

Professor Wilson, *Dean* (1005 School of Nursing, West Campus); Associate Professor Most, *Director of Academic Programs* (1004 School of Nursing, West Campus)

First Term

121S. Parenthood. An investigation of parenting behavior with a focus on the meaning of experiences to the mother and father and the means by which individuals can maximize the positive potential of these experiences. Open to sophomores or above and non-nursing majors. One course. Pass/fail option. *Harris.* 9:40-11:00. To be arranged.

167S. Poverty and Health. A study of poverty designed to develop an awareness of the relationship between poverty and health. Seminars, films, and actual experience with poverty groups will be used to acquaint the student with a di-

versity of perceptions and observations germane to an understanding of health problems among the poor. Open to sophomores and above including non-nursing majors with the permission of the instructor. One course. Pass/fail option. *Humphrey.* To be arranged.

169. Human Sexuality. A study of the intrapersonal, interpersonal, and sexual aspects of an individual's existence and the forces shaping prevailing and future sexual expressions and human sexuality. Open to non-nursing majors. One course. Pass/fail option. *Woods.* To be arranged.

191, 192, 193, or 194. Independent Study. Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum of one course. Pass/fail option. *Staff*

Second Term

191, 192, 193, or 194. Independent Study. (See description given in Term I.) *Staff*

Third Term

173. The Child with Diabetes: A Living-Learning Experience. This practicum offers opportunity to care for ambulatory children with diabetes mellitus in a residential summer camp setting. The focus is on principles of diet, medication, and activity modification in management of labile juvenile diabetes and on facilitating self-care by the child with a chronic disease. Open to rising seniors in the nursing major. (Also listed as MED-262 C.) One course. Pass/fail option. To be arranged. *Staff*

191, 192, 193, or 194. Independent Study. (See description given in Term I.) *Staff.*

Pathology

Professor Kinney, *Chairman* (M301, Davison Building); Professor Sommer, *Director of Graduate Studies* (301 Davison Building)

First Term

357. Research. Hours to be arranged. *Staff.*

361. Advanced General Pathology. See *Bulletin of the Graduate School* for description. 6 units. *Staff.*

Second Term

357. Research.

362. Advanced General Pathology. Second part of M361.

Third Term

357. Research. Hours to be arranged. *Staff.*

Philosophy

Professor Welsh, *Chairman* (201K West Duke Building, East Campus); Professor Peach, *Director of Graduate Studies* (201 West Duke Building, East Campus); Assistant Professor Ross, *Director of Undergraduate Studies* (201G West Duke Building, East Campus)

First Term

42. Introduction to Philosophy. Examination of problems in philosophy; emphasis on ethics and value theory. One course. *Bamford.* 11:20-12:40. 9.129.

112S. Philosophy of Mind. Such topics as mind and body, thought, perception, persons, and personal identity. One course. *Welsh.* 9:40-11:00. 9.129.

Second Term

106. Philosophy of Law. Natural law theory; legal positivism; legal realism; the relation of law and morality. One course. *Benditt.* 11:20-12:40. 9.133.

Third Term

108. Social Ideals and Utopias. Reading of selected Utopias; analysis of the value-structures and political principles of these ideal societies. One course. *Negley.* 11:20-12:40. 9.127.

Physics

Professor Newson, *Chairman* (119 Physics Building); Associate Professor Evans, *Director of Graduate Studies* (111 Physics Building); Associate Professor Roberson, *Director of Undergraduate Studies* (412 TUNL)

First Term

51. General Physics. This course treats the basic principles of general physics in a quantitative manner. It meets in a thorough way the physics requirement for entrance into the study of either medicine or engineering, and is well suited for the general science student. This course is not open for credit for students who have completed Physics 41-42. Prerequisites: Math. 31, 32, or equivalent. One laboratory course. *Evans.* 9:40-4:00. 49.114.

Second Term

52. General Physics. A continuation of Physics 51. Prerequisite: Physics 51. One laboratory course. *Evans.* 9:40-4:00. 49.114.

Third Term

55. Astronomy. Man's evolving theory of the physical universe. Cosmological models, galaxies, stars, interstellar matter, the solar system, and experimental techniques and results. Optional observational laboratory. One course. *De Lucia.* 8:00-9:20. 49.113.

255. Astronomy for Teachers. Observational techniques and the use of telescopes. Evolution of planetary atmospheres and interiors, stellar evolution, galaxies, cosmology. Observatory observation. One course. *De Lucia.* 8:00-9:20. 49.113.

Physiology

Professor Tosteson, *Chairman* (388 Medical Sciences I); Associate Professor McManus, *Director of Graduate Studies* (354 Medical Sciences I)

Third Term (Duke Marine Laboratory, Beaufort)

212L. Membrane Physiology and Osmoregulation. Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in marine plants and animals. Laboratory work deals with ionic transport processes in gills and other epithe-

lia, basic electrophysiology and synaptic transmission in mollusks, kidney function in fish, amino acid transport and metabolism in crustaceans, and the application of radio-tracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). *Gutknecht and Staff.*

Political Science

Professor Barber, *Chairman* (214 Perkins Library); Professor Fish, *Director of Graduate Studies* (308 Perkins Library); Professor Hall, *Director of Undergraduate Studies* (314 Perkins Library)

First Term

131. Introduction to American Political Thought. Basic elements in the American political tradition as developed from its English roots to the present. One course. *Leach.* 9:40-11:00. 4.301.

157. United States Foreign Policy. An analytical survey of the source of and constraints upon American foreign policy. Prominent theories of American diplomacy in the light of external undertakings. One course. *Holsti.* 11:20-12:40. 4.301.

Second Term

117. Comparative Legal Systems. Origins, development and mutual influences of modern legal systems: Roman and civil law; the Common Law and the Anglo-Saxon tradition; Islamic law; communist legal systems and the legal systems of Black Africa. One course. *Grzybowski.* 11:20-12:40. 4.301.

241. Public Administrative Organization and Management. An examination of the American administrative process, with emphasis upon the theory and practice of administrative organization and management. One course (3 graduate units). *Hall.* 9:40-11:00. 4.301.

Third Term

127. Law and Politics. Nature and functions of law; Anglo-American legal institutions, the process of judicial decision-making, and the relationships among judges, lawyers, legislators and administrators in the development of public as well as private law. One course. *Fish.* 9:40-11:00. 4.301.

Psychology

Professor Alexander, *Chairman* (244 Sociology-Psychology); Professor Staddon, *Director of Graduate Studies* (107 Sociology-Psychology); Professor Wing, *Director of Undergraduate Studies* (316 Sociology-Psychology)

Details concerning the program of studies in psychology may be obtained from the brochure *Graduate Studies in Psychology.*

First Term

102. Sensation, Perception, and Learning. Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sherrington) and behavioral (Pavlov). Complex organization: learning, perception, and cognition. One course. *Lockhead.* 11:20-12:40. 9.127.

105. Developmental Psychology. Theory and research on growth and behavior from infancy to adolescence. One course. *Staff.* 9:40-11:00. 9.126.

101. Social Psychology. Problems, concepts, and methods in the study of social interaction and interpersonal influence. Prerequisite: one course in psychology at the 90-level or permission of the instructor. One course. *Staff.* 8:00-9:20. 9.127.

170A. (Summer Program in Israel.) One course. *Alexander.*

Second Term

103. Biological Basis of Behavior. Behavior as a product of evolution and the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. *Kalat.* 11:20-12:40. 9.126.

104. Personality. Representative theories of personality from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. One course. *Carson.* 9:40-11:00. 9.126.

165. Personality Theory. Theories of personality from larger metatheoretical perspectives. Open to junior and senior majors in psychology, or by permission of the instructor. Prerequisite: Psychology 94. One course. *Staff.* 8:00-9:20. 9.126.

Third Term

138. Abnormal Psychology. Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 94 or 95. One course. *Staff.* 11:20-12:40. 9.126.

Religion

Professor Poteat, *Chairman* (117B Gray); Professor Smith, *Director of Graduate Studies* (209A Divinity); Associate Professor Kort, *Director of Undergraduate Studies* (218 Gray)

First Term

52. The New Testament. Origins, development, and content of thought. Not open to students who have had Religion 55 or 55D. One course. *Price.* 9:40-11:00. 3.220.

105. Theology of the Old Testament. Emphasis upon history and eschatology, convenant, messianism, and wisdom. One course. *Wintermute.* 1:20-2:40. 3.220.

142. Myth and Symbol. Historical and phenomenological study of religious myths and symbols, Christian and non-Christian. One course. *Partin.* 8:00-9:20. 3.220.

151. Ethical Issues in Social Change and Public Policy. American moral tradition and factors in social change in the normative analysis of public policy, with a consideration of specific ethical issues. One course. *McCollough.* 11:20-12:40. 3.220.

Second Term

107. Theology of the New Testament. A systematic analysis of the theologies of the New Testament writers and an attempt to synthesize the basic and shared themes. One course. *Charlesworth.* 8:00-9:20. 3.220.

170. Problems of Religious Thought. Analysis of credentials for belief in God. One course. *Poteat.* 9:40-11:00. 3.220.

188. Recent Literature and its Religious Implications. Religious elements in recent literature. One course. *Kort.* 11:20-12:40. 3.220.

Third Term

154. Ethics and Modern Technology. Emerging ethical issues created by the impact of technology on the psychological, social, political, and economic life of modern man. One course. *Clark.* 9:40-11:00. 3.220.

JUDAIC STUDIES SUMMER PROGRAM IN ISRAEL

Program I.

Courses in Jerusalem, May 18-June 14.

Religion 195C. Seminar on Israel and Judaism. *Dr. K. Bland.*
Religion 196C. Seminar on Mystical Sources for Hasidism. *Dr. K. Bland.*
Psychology 170. Problems of Jewish Identity. *Dr. I. Alexander.*

Courses at Excavations at Meiron, June 15-July 13.

Religion 131D. Principles of Archaeological Excavation. *Dr. E. Meyers.*
Religion 132D. Palestine in Late Antiquity. *Dr. E. Meyers.*

Program II.

Excavations at Meiron, June 14-August 9.

Religion 131D. Principles of Archaeological Excavation. *Dr. E. Meyers.*
Religion 132D. Palestine in Late Antiquity. *Dr. E. Meyers.*

Romance Languages

Professor Tetel, *Chairman* (205A Language Center); Associate Professor Vincent, *Director of Graduate Studies* (214 Language Center)

FRENCH

First Term

76. Practice in everyday conversational French. Prerequisite: French 63 or equivalent. Limited to fifteen students. One course. *Steegar.* 11:20-12:40. 5.208.

141S. Reality and Fiction, Medieval and Modern. Prose readings from Chrétien de Troyes, Balzac, Flaubert, Fournier. One course. *Ripley.* 11:20-12:40. 5.217.

181. Intensive French. An intensive introduction to the language. (Also equivalent to Graduate Reading Course.) One course. *Tetel.* 9:40-11:00. 5.217.

Second Term

100. Active French. Intensive instruction in oral and written expression. Prerequisite: French 76 or equivalent. Limited to fifteen students. One course. *Bryan.* 11:20-12:40. 5.219.

152. André Gide: the Art of Fiction and Autobiography. A critical approach to the major books and to Gide's use of Greek myths and a comparative study of these myths in English and German literatures. (Also listed as Comparative Literature 152.) Readings in English or French. Graduate credit can be arranged. One course. *Fowlie.* 8:00-9:30. 5.014.

182. Intensive French. Readings in modern literature. One course. *Niess.* 9:40-11:00. 5.211.

Third Term

131. French Canadian Literature. Study of French Canadian works of major importance from the origins to the present (Louis Hémon to Hubert Aquin). Emphasis on the social, economic, and cultural rise of Québec, especially in the present day. Readings in French or English. Course conducted in English. Graduate credit can be arranged. One course. *Bouygues.* 11:20-12:40. 5.305.

SPANISH

First Term

141S. Masterpieces of Spanish Lyric Poetry. A study in the original and in English translation of the major Spanish poets from Jorge Manrique to García Lorca. Open to students who know no Spanish. One course. *Landeira.* 11:20-12:40. 5.305.

181. Spanish. An intensive introduction to the language. One course. *Landeira.* 9:40-11:00. 5.305.

Second Term

100. Active Spanish. Intensive instruction in oral and written expression. Prerequisite: Spanish 76 or equivalent. Limited to fifteen students. One course. *Miller.* 11:20-12:40. 5.211.

182. Readings in Spanish American Literature. Readings in Modern Literature. One course. *Miller.* 9:40-11:00. 5.208.

Science and Mathematics Institute

Courses offered will depend upon demand and degree of government support. Interested teachers should write *as early as possible* to Professor Sherwood Githens and express course interests. Available State tuition grants will go to the qualified eligible students who inquire the earlies. Courses below can be counted toward M.Ed. and M.A.T. degrees. See also under botany, chemistry, computer science, geology, mathematics, physics, and zoology.

Second Term

Chemistry 211, 212. Chemistry for Teachers I & II. A study of the principles of modern chemistry with particular reference to the environmental, ecological, and interdisciplinary aspects of modern technology. Open only to teachers of biology, chemistry, and general science. Lecture, recitation, and laboratory or field trips daily. 6 units. *Wilder.* 8:00-4:00.

Third Term

Physical Science 201. Physical and Electrical Phenomena. Quantitative study of the primary measurable physical and electrical properties of matter and forms of energy, emphasizing processes of measurement and analysis and the metric system. Designed for teachers. July 18-August 8 (3 weeks). 3 units. *Githens.* 9:45-11:15, plus laboratories to be arranged.

Physical Science 202. Chemical Properties, Substances, and Reactions. Quantitative laboratory measurements, calculations, and analyses. Emphasis on the relationships between atomic structure and the chemical, physical, and electrical properties of matter. Designed for teachers. 3 units. *Githens.* 1:00-5:00.

Sociology

Professor Kerckhoff, *Chairman* (268 Sociology-Psychology); Professor Smith,

Director of Graduate Studies (332 Sociology-Psychology); Assistant Professor House, *Director of Undergraduate Studies* (277A Sociology-Psychology)

First Term

91. Introduction to Sociology: Concepts and Procedures. Concepts and procedures of sociology and illustrations of their use in understanding specific areas of social life. Open to freshmen. One course. *Roy.* 9:40-11:00. 9.248.

155. Sociology of Work. Study of the social organization of work activities, of the human experiences and group relationships involved. Special focus on management-employee conflict and cooperation. One course. *Roy.* 8:00-9:20. 9.248.

Second Term

120. Perspectives on Deviant Social Behavior. Development and distribution of deviant social behavior, treating such topics as social disorganization, stress and strain, cultural and labeling theories in relation to crime and delinquency, drug addiction, homosexuality, suicide, or others. (Not open to students who have taken Sociology 143.) One course. *Preiss.* 8:00-9:20. 9.127.

259. Religion and Social Change. The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, and glossolalia). Prerequisite: Anthropology 264 or Sociology 151, or the equivalent. One course (3 graduate units). *Tiryakian.* 9:40-11:00. 9.133.

272. The Socialization Process. Mechanisms and variations in socialization by position in the social structure (class, caste, and urban-rural); contributions made by various social agencies (family, school, peer groups, and mass media) in Western society. One course. *Preiss.* 11:20-12:40. 9.127.

Third Term

251. The Sociology of Modernization. Theories and perspectives on the nature of modernization and modernity in Western and non-Western countries. One course (3 graduate units). *Borinski.* 9:40-11:00. 9.133.

255. Race and Culture. A comparative study of race relations in world perspective developed around such themes as race and personal identity, the geography and ecology of race relations, and the idea of race, and race conflict. One course (3 graduate units). *Borinski.* 11:20-12:40. 9.129.

Zoology

Professor Fluke, *Chairman* (227 Biological Sciences); Associate Professor Wainwright, *Director of Graduate Studies* (024 Biological Sciences); Associate Professor Ward, *Director of Undergraduate Studies* (032 Biological Sciences)

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking B.A., B.S., M.A., or Ph.D. degrees.

Students seeking undergraduate degrees should consult the *Bulletin of Undergraduate Instruction* for a statement of major requirements. A departmental handbook available from the office of the Director of Undergraduate Studies describes the advising system, typical courses of study, special programs, and interests and background of the faculty.

In general, a graduate student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in

biology, along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, Anthropology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For registration dates see General Registration pages 27-28 of this *Bulletin*. For detailed instructions and further information on the offerings at Beaufort, see the *Bulletin of the Duke University Marine Laboratory*.

First Term (Durham Campus)

117. Heredity and Society. An introduction to genetics with emphasis on the effects of environment and heredity upon the individual and the population. A student may not receive credit for both Zoology 117 and 180 or Nursing 105. Prerequisite: college biology or permission of the instructor. One course. *Ward.* 9:40-11:10 Monday through Friday. 58.113.

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

353. Research. Hours to be arranged. 2-6 units. *Staff.*

First Term (Duke Marine Laboratory, Beaufort)

114L. Introduction to Biological Oceanography. Physical, chemical and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: college biology. One and one-half courses. *Cox.*

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

353. Research. Hours to be arranged. 2-6 units. *Staff.*

Second Term (Durham Campus)

192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

201. Animal Behavior. Emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics, and evolution, or permission of the instructor. One course. *Rosenson.* 9:40-11:10 Monday through Friday. 58.113.

354. Research. Hours to be arranged. 2-6 units. *Staff.*

Second Term (Duke Marine Laboratory, Beaufort)

192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

203L. Marine Ecology. Class discussion on selected papers and field projects; practice in scientific writing and use of computers in ecology. Prerequisites: a course in general zoology, invertebrate zoology, or an appropriate equivalent, and a year of mathematics; some knowledge of statistics will be helpful. One and one-half courses (6 graduate units). *Sutherland.*

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 161, 162 or equivalent); statistics (Mathematics 183, or equivalent), or permission of the instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. One and one-half laboratory courses (6 graduate units.) *Baier.*

250L. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. One and one-half courses (6 graduate units). *Forward.*

278L. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: permission of the instructor. One and one-half courses (6 graduate units). *Bookhout.*

354. Research. Hours to be arranged. 2-6 units. *Staff.*

Third Term (Durham Campus)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

225. Introduction to Field Zoology. The study of animals in their native habitats with emphasis on habitats, collection, identification, life histories, and ecological relationships. Attention will be paid to familiarizing teachers with animals in the field. Field work will be limited to the Piedmont. Practical uses of field studies in teaching will be stressed. Prerequisite: Zoology 211, Zoology for Teachers (formerly Zoology S205), or equivalent. Restricted to students in the MAT or NSF programs. 3 units. *Staff.* Daily 1:00-5:00. 58.113; laboratory, 58.115.

353. Research. Hours to be arranged. 2-6 units. *Staff.*

Third Term (Duke Marine Laboratory, Beaufort)

191T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. *Staff.*

202L. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lecture and laboratory. Prerequisite: one course in physiology. One and one-half courses (6 graduate units). *Salmon.*

214L. Biological Oceanography. Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Ship-board investigations of the biological productivity of the continental shelf ecosystem. Prerequisite: permission of the instructor. (Given at Beaufort.) One and one-half courses (6 graduate units). *Barber.*

230. Chemical Pollution of Coastal Waters. Sources and sinks for chemical pollutants and impact on coastal biomes. Laboratory and field experiments to il-

lustrate problems in verifying the extent of chemical pollution. Analysis of exemplary chemical plants to derive plans for pollution control. Prerequisites: Chemistry 161 and 162 or equivalent, Chemistry 132 or equivalent, and calculus, or permission of the instructor. (Given at Beaufort.) One and one-half courses (6 graduate units). *Baier.*

274L. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips included. Not open to students who have had Zoology 275. Prerequisite: introductory college biology. One and one-half courses (6 graduate units). *Dimock.*

353. Research. Hours to be arranged. 2-6 units. *Staff.*



Calendar of the Summer Session

1975

First Term: May 13-June 14
Second Term: June 16-July 17
Third Term: July 18-August 19

May

13	Tuesday—Summer Session begins
19	Monday—First class day for chemistry and physics

June

14	Saturday—First Term ends
16	Monday—Term II of Summer Session begins
21	Saturday—Classes will be held

July

4	Friday—Holiday
11	Friday—Classes end in chemistry and physics
12	Saturday—Classes will be held
17	Thursday—Second Term ends
18	Friday—Term III of the Summer Session begins
19	Saturday—Classes will be held

August

16	Saturday—Classes will be held
19	Tuesday—Third Term ends

Directions to Summer Session Applicants.

All applicants for summer session courses who are not now in residence at Duke University must fill out accurately and in detail the form below and return it to the Director of the Summer Session. Preference in enrollment will be given to persons returning the form promptly, but a place in a particular course cannot be assured until all fees are paid. Undergraduates or graduates who are enrolled in a university or college other than Duke University and who are seeking to transfer summer session credits to the college in which they are matriculated should request a course approval form to be certified by their dean or registrar. Graduate students are reminded that credit earned as an unclassified graduate student cannot be applied toward an advanced degree at Duke University. Persons applying for admission to the Graduate School of Duke University should write the Dean of the Graduate School for the necessary forms in addition to completing the form on page 73.

Undergraduates, both men and women, are required to live in the residence halls unless they are married or living with parents or relatives or have received permission to reside off campus for the previous or subsequent academic year. Any exception must be approved in advance by the Dean of Students.

Application for Enrollment in the Duke University Summer Session

Mr., Mrs., Miss _____
(Please Print)

Street Address, Rural Route, or P. O. Box _____

Post Office _____ State _____ Zip Code _____

Social Security No. _____

Please register me in the following courses listed in the *Bulletin of the Summer Session.*

Department	No. of Course	Title of Course

Name and address of high school from which you graduated _____

Have you attended a college? Yes _____ No _____

Name and address of college _____

Highest degree held _____

Are you a candidate for a degree? Yes _____ No _____

If yes, for which degree? _____

Check the one below which indicates your present University status. (Do not indicate a status in a Duke University School or College unless you have already been admitted to that School or College)

Undergraduate credits

Trinity College of Arts and Sciences
School of Nursing
School of Engineering
Special or unclassified
Credits for transfer

Graduate credits

Graduate School
Divinity School
School of Forestry
Special or unclassified
Credits for transfer

Are you applying for admission to the Graduate School? _____

Are you at present a college student? _____ If so, where? _____

What class? _____

See Reverse

Are you a full-time teacher? _____

If so, give name and address of school _____

_____

Teaching Position:

Elementary: _____

Secondary: _____

Administrator: _____

Supervisor: _____

Have you attended previous Summer Sessions at Duke? Yes _____

Years _____ No _____

Do you wish credit certified to some agency or school? Yes: _____ No: _____

If yes, please give exact name and address of agency or school. _____

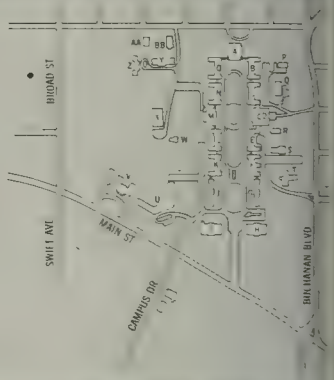
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MAP OF DUKE UNIVERSITY

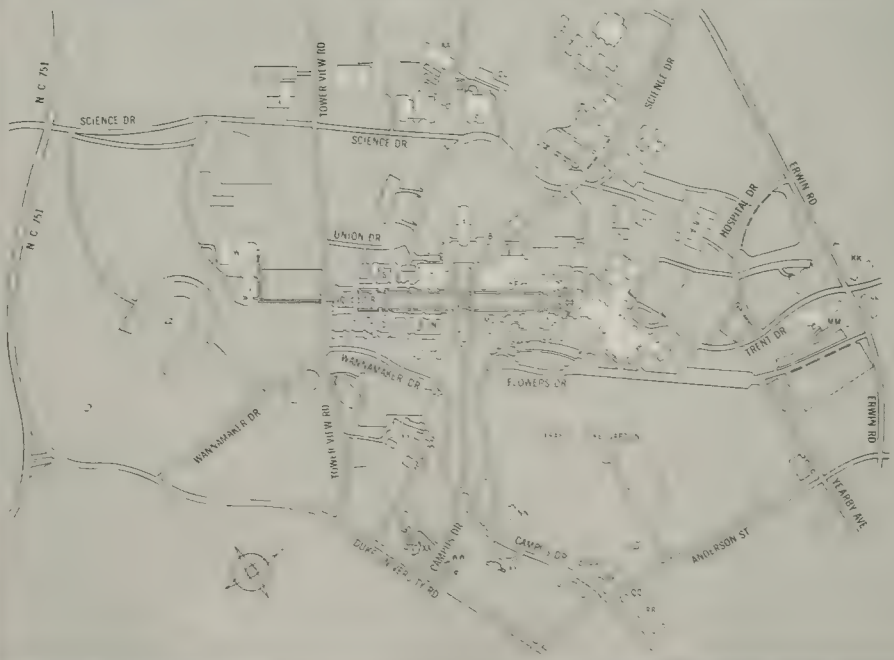
East Campus

- A Baldwin Auditorium
- B Bassett House
- C Brown House
- D Union Building
- E Faculty Apartments
- F Art Museum, Geology
- G Aycock House
- H East Duke Building
- I West Duke Building
- J Jarvis House
- K Carr Building
- L Giles House
- M Woman's College Library
- N Alspaugh House
- O Pegram House
- P Duke Press
- Q Infirmary
- R Ark
- S Crowell Building
- T Epworth Inn
- U Gilbert Addoms House
- V Southgate Hall
- W Campus Center
- X Woman's College Gymnasium
- Y Asbury Building
- Z Bivins Building
- AA Art Building
- BB Branson Building



West Campus

- A Duke Chapel
- B Divinity School
- C Gray Building
- D Perkins Library
- E Language Center
- F Old Chemistry Building
- G Davison Building, School of Medicine
- H Hospital Main Entrance
- I Gerontology, D & T, Clinical Research
- J Duke Hospital
- K Sociology, Psychology
- L Social Sciences
- M Allen Building
- N Few Quadrangle
- O Craven Quadrangle
- P Wannamaker Hall
- Q Crowell Quadrangle
- R Clock Tower Court
- S Kilgo Quadrangle
- T Union Building
- U Flowers Building, Page Auditorium
- V Card Gymnasium
- W Indoor Stadium
- X School of Law
- Y Gross Chemical Lab
- Z Biological Sciences
- AA Plant Environment Laboratory
- BB Physics Building
- CC Nuclear Laboratory
- DD School of Engineering
- EE Army Research
- FF Medical Center Research Buildings
- GG Nanaline H. Duke Nursing Sciences Building
- HH Warehouse, Shop
- II Bell Building
- JJ Hanes House, School of Nursing
- KK Hanes House Annex
- LL Pickens Rehabilitation Center
- MM Graduate Center
- NN Alumni House
- OO Commonwealth Studies Center
- PP Personnel Office
- QQ International House
- RR Personnel Office
- SS Educational Improvement Program, A Better Chance Program
- TT International Studies Center
- UU Campus Stores Office
- VV Office of Institutional Advancement
- WW Information Services, Visitors Bureau
- XX Admissions Office
- YY Edens Quadrangle
- ZZ Wade Stadium





Bulletin of Duke University Summer Session Vol. 47 January, 1975 Number 5



1975-1976
BULLETIN OF
DUKE UNIVERSITY

The Graduate School

Bulletin of Duke University

Graduate School

1975-1976

Durham, North Carolina 1975

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Calendar of the Graduate School 1975-1976

1975

April

1	Tuesday—Last day for submitting dissertations for Ph.D. and Ed.D. degrees.
2-3	Wednesday-Thursday—Registration for fall and summer, 1975.
15	Tuesday—Last day for submitting theses for A.M., M.S., M.Ed., and M.A.T. degrees.
15	Tuesday—Final date for completing application for admission to the summer session, Term I.
21	Monday—Spring semester classes end.
22-28	Tuesday-Monday—Reading period.
29	Tuesday—Final examinations begin.

May

6	Tuesday—Final examinations end.
9	Friday—Completion of registration for summer session, Term I.
10	Saturday—Commencement begins.
11	Sunday—Baccalaureate Services and Commencement Exercises.
13	Tuesday—Summer session begins except for undergraduate courses in chemistry and physics.
15	Thursday—Final date for completing application for admission to the summer session, Term II.
19	Monday—First class day for chemistry and physics.

June

13-14	Friday-Saturday—Final examinations for Term I.
13	Friday—Completion of registration for Term II.
14	Saturday—Term I ends.
16	Monday—Final date for completing application for admission to the summer session, Term III.
16	Monday—First class day for all courses in Term II.
21	Saturday—Classes will be held.

July

4	Friday—Holiday.
12	Saturday—Classes will be held.
16-17	Wednesday-Thursday—Final examinations for Term II.
17	Thursday—Term II ends.
17	Thursday—Completion of registration for Term III.
18	Friday—First class day for Term III.
19	Saturday—Classes will be held.

August

1 Friday—Final date for filing with the Graduate School Office the Statement of Intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the Statement of Intention.
15 Friday—Last day for submitting theses for advanced degrees.
16 Saturday—Classes will be held.
18-19 Monday-Tuesday—Final examinations for Term III.
19 Tuesday—Final date for completion of requirements for Graduate School degrees to be awarded September 1.
19 Tuesday—Term III ends.

Academic Year 1975-1976

25-27 Monday-Wednesday—Registration and matriculation of all new and nonregistered returning students in the Graduate School.
25-27 Monday-Wednesday—Consultation with directors of graduate study concerning course programs.
26 Tuesday, 9:00 a.m.—English examination for foreign students, 111 Biological Sciences Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)

September

2 Tuesday, 9:00 a.m.—Fall semester classes begin.
3 Wednesday, 4:00-6:00 p.m.—Drop/Add begins. Indoor Stadium.
4-5 Thursday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
8-12 Monday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
12 Friday—Final date for changes in registration which involve adding courses, provided no reduction in fees is entailed.
26 Friday—Final date for dropping course-seminar registration and adding equivalent units of research.

October

3 Friday—Final date for change in registration resulting from passing a preliminary examination.
27-28 Monday-Tuesday—Registration for spring, 1976.

November

25 Tuesday, 6:00 p.m.—Thanksgiving recess begins.

December

1 Monday, 9:00 a.m.—Classes are resumed.
4 Thursday, 6:00 p.m.—Fall semester classes end.
5-11 Friday-Thursday—Reading period.
7 Sunday—Founders' Day.
12 Friday—Final examinations begin.
19 Friday—Final examinations end.

1976

January

7 Wednesday, 2:00 p.m.—English examination for foreign students, 309 Flowers Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)
9 Friday—Registration for new and nonregistered returning students.
12 Monday, 9:00 a.m.—Spring semester classes begin.
13 Tuesday, 4:00-6:00 p.m.—Drop/Add begins. Indoor Stadium.
14-16 Wednesday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
19-23 Monday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
23 Friday—Final date for changes in registration which involve adding courses, provided that no reduction in fees is entailed.

February

2 Monday—Final date for filing with the Graduate School Office the Statement of Intention of receiving an advanced degree in May. Titles of theses and dissertations are to be filed concurrently with the Statement of Intention.

6 Friday—Final date for dropping course-seminar registration and adding equivalent units of research.

13 Friday—Final date for change in registration resulting from passing a preliminary examination.

March

5 Friday, 6:00 p.m.—Spring recess begins.

15 Monday, 9:00 a.m.—Classes are resumed.

29-30 Monday-Tuesday—Registration for fall and summer, 1976.

April

1 Thursday—Last day for submitting dissertations for Ph.D. and Ed.D. degrees.

15 Thursday—Last day for submitting theses for A.M., M.S., M.Ed., and M.A.T. degrees.

15 Thursday—Last day for applying to the summer session, Term I, 1976.

19 Monday, 6:00 p.m.—Spring semester classes end.

20-26 Tuesday-Monday—Reading period.

27 Tuesday—Final examinations begin.

May

4 Tuesday—Final examinations end.

8 Saturday—Commencement begins.

9 Sunday—Baccalaureate Services and Commencement Exercises.

14 Friday—Final date for completing application for admission to the summer session, Term II, 1976.



University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
John O. Blackburn, Ph.D., *Chancellor*
Frederic N. Cleaveland, Ph.D., *Provost*
Charles B. Huestis, *Vice President for Business and Finance*
William G. Anlyan, M.D., *Vice President for Health Affairs*
Juanita M. Kreps, Ph.D., *Vice President*
J. David Ross, J.D., *Vice President for Institutional Advancement*
Victor A. Bubas, B.S., *Vice President for Community Relations*
Stephen Cannada Harward, A.B., C.P.A., *Treasurer and Assistant Secretary*
J. Peyton Fuller, A.B., *Assistant Vice President and Controller*
Harold W. Lewis, Ph.D., *Vice Provost and Dean of Faculty*
John C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*
John M. Fein, Ph.D., *Vice Provost and Dean of Trinity College of Arts and Sciences*
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*
Anne Flowers, Ed.D., *Assistant Provost for Educational Program Development*
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
Joel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs*
Benjamin Edward Powell, Ph.D., *Librarian*
William E. King, Ph.D., *University Archivist*
Clark R. Cahow, Ph.D., *University Registrar and Acting Director of Admissions*
Olan Lee Petty, Ph.D., *Director of the Summer Session*
Rufus H. Powell, LL.B., *Secretary of the University*
Charles Linn Haslam, J.D., *University Counsel*

Graduate School Administration

John C. McKinney, Ph.D., *Dean of the Graduate School*
William G. Katzenmeyer, Ed.D., *Associate Dean*
Charles M. Harman, Ph.D., *Associate Dean*
Pauline D. Myers, *Assistant to the Dean*
Frances C. Thomas, A.B., *Administrative Assistant*

Executive Committee of the Graduate Faculty

Dean John C. McKinney

M. Margaret Ball*
Robert L. Barnes (Alt.)
Jack B. Chaddock (Alt.)*
Donald B. Chesnut*
Ernestine Friedl
Gregory R. Lockhead (Alt.)
Thomas J. McManus*
Holger O. Nygard
Merrell L. Patrick (Alt.)
Marcel Tetel (Alt.)*
Stephen A. Wainwright (Alt.)*
Seth L. Warner
E. Roy Weintraub (Alt.)*
Hilda P. Willett
William H. Willis*
Franklin W. Young (Alt.)

*Term expires September, 1975.

Instructional Staff

Members of the Graduate School Faculty

(As of October 1, 1974.)

The date denotes the first year of service at Duke University.

Francis Dorothy Acomb (1945), Ph.D., *Professor of History*
Anne H. Adams (1971), Ed.D., *Professor of Education*
Dolph O. Adams (1972), M.D., Ph.D., *Assistant Professor of Pathology*
Mark R. Adelman (1971), Ph.D., *Assistant Professor of Anatomy*
David Aderman (1970), Ph.D., *Assistant Professor of Psychology*
John Richard Alden (1955), Ph.D., *James B. Duke Professor of History*
Irving Alexander (1963), Ph.D., *Professor of Psychology*
A. Tilo Alt (1961-65; 1967), Ph.D., *Assistant Professor of German*
D. Bernard Amos (1962), M.D., *James B. Duke Professor of Immunology*
Carl Anderson (1955), Ph.D., *Professor of English*
[1]Lewis Edward Anderson (1936), Ph.D., *Professor of Botany*
Nels C. Anderson (1966), Ph.D., *Associate Professor of Physiology*
Roger Fabian Anderson (1950), Ph.D., *Professor of Forest Entomology*
Janis Antonovics (1970), Ph.D., *Associate Professor of Botany*
Stanley Hersh Appel (1964-65; 1967), M.D., *Associate Professor of Biochemistry*
Mahadev L. Apte (1965), Ph.D., *Associate Professor of Anthropology*
John Leslie Artley (1955), D.Eng., *Professor of Electrical Engineering*
Kurt W. Back (1959), Ph.D., *Professor of Sociology*
Rodger W. Baier (1972), Ph.D., *Assistant Professor of Chemistry*
Joseph Randle Bailey (1946), Ph.D., *Professor of Zoology*
Lloyd Richard Bailey (1971), Ph.D., *Associate Professor of Old Testament*
Frank Baker (1960), Ph.D., *Professor of Religion*
Kenneth R. Baker (1973), Ph.D., *Professor of Business Administration*
Jeannie M. Baldigo (1974), Ph.D., *Assistant Professor of Sociology*
Steven W. Baldwin (1970), Ph.D., *Assistant Professor of Chemistry*
Helmy Hamdollah Baligh (1967), Ph.D., *Professor of Business Administration*
M. Margaret Ball (1963), Ph.D., *Professor of Political Science*
Robert H. Ballantyne (1962), Ed.D., *Associate Professor of Education*
James David Barber (1972), Ph.D., *Professor of Political Science*
Richard T. Barber (1970), Ph.D., *Associate Professor of Zoology and Associate Professor of Botany*
Robert Lloyd Barnes (1965), Ph.D., *Professor of Forest Biochemistry*
Roger C. Barr (1969), Ph.D., *Associate Professor of Biomedical Engineering*
Joseph Battle (1970), Ph.D., *Associate Professor of Business Administration*
William Waldo Beach (1946), Ph.D., *Professor of Christian Ethics*
Robert D. Behn (1973), Ph.D., *Associate Professor of Public Policy Sciences*
[2]Joseph C. Bell (1972), LL.B., *Assistant Professor of Public Policy Sciences*
[3]Robert M. Bell (1972), Ph.D., *Assistant Professor of Biochemistry*

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[1]Sabbatical leave, academic year, 1974-75.
[2]Leave of absence, academic year, 1974-75.
[3]Leave of absence, academic year, 1974-75

Theodore Benditt (1970), Ph.D., *Assistant Professor of Philosophy*
Peter B. Bennett (1972), Ph.D., *Professor of Biomedical Engineering*
Jan A. Bergeron (1969), V.M.D., *Assistant Professor of Anatomy and Assistant Professor of Zoology*
Charles W. Bergquist (1972), Ph.D., *Assistant Professor of History*
Frederick Bernheim (1930), Ph.D., *James B. Duke Professor of Pharmacology*
William Bevan (1974), Ph.D., *William Preston Few Professor of Psychology*
L. C. Biedenharn, Jr. (1961), Ph.D., *Professor of Physics*
Alan Biermann (1974), Ph.D., *Assistant Professor of Computer Science*
Darell D. Bigner (1972), M.D., Ph.D., *Associate Professor of Pathology*
William Dwight Billings (1952), Ph.D., *James B. Duke Professor of Botany*
Edward George Bilpuch (1962), Ph.D., *Professor of Physics*
John A. Bittikofer (1970), Ph.D., *Associate in Biochemistry*
David E. Black (1969), Ph.D., *Assistant Professor of Economics*
[4]John O. Blackburn (1962), Ph.D., *Professor of Economics*
William F. Blankley (1972), Ph.D., *Assistant Professor of Botany*
Charles A. Blake (1972), Ph.D., *Assistant Professor of Anatomy*
J. J. Blum (1962), Ph.D., *Professor of Physiology*
Bruce R. Bolnick (1974), Ph.D., *Assistant Professor of Economics*
Dani P. Bolognesi (1971), Ph.D., *Assistant Professor of Microbiology*
Joseph Bonaventura (1972), Ph.D., *Associate Professor of Biochemistry*
Cazlyn Green Bookhout (1935), Ph.D., *Professor of Zoology*
[5]James Alexander Boon (1974), Ph.D., *Assistant Professor of Anthropology*
Frank Borchardt (1971), Ph.D., *Associate Professor of German*
Lloyd J. Borstelmann (1953), Ph.D., *Professor of Psychology*
Edward H. Bossen (1972), M.D., *Assistant Professor of Pathology*
John E. Boynton (1968), Ph.D., *Associate Professor of Botany*
William D. Bradford (1966), M.D., *Associate Professor of Pathology*
David G. Bradley (1949), Ph.D., *Professor of Religion*
Charles Kilgo Bradsher (1939), Ph.D., *James B. Duke Professor of Chemistry*
[6]Ralph Braibanti (1953), Ph.D., *James B. Duke Professor of Political Science*
Eleanor F. Branch (1972), Ph.D., *Associate Professor of Physical Therapy*
Jack W. Brehm (1958), Ph.D., *Professor of Psychology*
Gert Brieger (1970), M.D., Ph.D., *Associate Professor of History*
Martin Bronfenbrenner (1971), Ph.D., *William R. Kenan, Jr. Professor of Economics*
Earl Ivan Brown, II (1960), Ph.D., *J. A. Jones Professor of Civil Engineering*
C. Edward Buckley, III (1963), M.D., *Associate Professor of Immunology*
Rebecca Buckley (1968), M.D., *Associate Professor of Immunology*
Louis J. Budd (1952), Ph.D., *Professor of English*
Donald S. Burdick (1962), Ph.D., *Associate Professor of Mathematics*
Peter H. Burian (1968), Ph.D., *Assistant Professor of Classics*
R. O. Burns (1964), Ph.D., *Professor of Microbiology*
Richard M. Burton (1970), D.B.A., *Associate Professor of Business Administration*
Ronald Richard Butters (1967), Ph.D., *Associate Professor of English*
Gale H. Buzzard (1957), Ph.D., *Assistant Professor of Mechanical Engineering*
Edwin H. Cady (1973), Ph.D., *Professor of English*
Philip Calkins (1973), Ph.D., *Assistant Professor of History*
Richard Campbell (1974), Ph.D., *Assistant Professor of Sociology*
Peter F. Carbone (1966), Ed.D., *Associate Professor of Education*
Leonard Carlitz (1932), Ph.D., *James B. Duke Professor of Mathematics*
Robert C. Carson (1960), Ph.D., *Professor of Psychology*
Reginald D. Carter (1970, Ph.D., *Assistant Professor of Physiology*
Matthew Cartmill (1969), Ph.D., *Associate Professor of Anatomy and Associate Professor of Anthropology*
William H. Cartwright (1951), Ph.D., *Professor of Education*
Ernesto Caserta (1970), Ph.D., *Assistant Professor of Romance Languages*
John H. Casseday (1970), Ph.D., *Lecturer in Psychology*
[7]Ronald W. Casson (1971), Ph.D., *Assistant Professor of Anthropology*
John Cell (1962), Ph.D., *Associate Professor of History*
Jack B. Chaddock (1966), Sc.D., *Professor of Mechanical Engineering*

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[4]Sabbatical leave, fall semester, 1974.
[5]Leave of absence, academic year, 1974-75.
[6]Sabbatical leave, spring semester, 1975.
[7]Leave of absence, fall semester, 1974.

[8]William Chafe (1971), Ph.D., *Associate Professor of History*
James H. Charlesworth (1969), Ph.D., *Assistant Professor of Religion*
Donald B. Chesnut (1965), Ph.D., *Professor of Chemistry*
Norman L. Christensen (1973), Ph.D., *Assistant Professor of Botany*
Edgar W. Clark (1970), Ph.D., *Associate Professor of Forest Entomology*
[9]Henry B. Clark (1966), Ph.D., *Associate Professor of Religion*
Howard G. Clark (1968), Ph.D., *Associate Professor of Biomedical Engineering and Associate Professor of Mechanical Engineering*
Frederic N. Cleaveland (1971), Ph.D., *Professor of Political Science*
John Clubbe (1966), Ph.D., *Associate Professor of English*
Franklin H. Cocks (1972), Ph.D., *Associate Professor of Mechanical Engineering*
Kalman J. Cohen (1974), Ph.D., *Professor of Business Administration*
[10]John D. Coie (1968), Ph.D., *Associate Professor of Psychology*
James M. Colacino (1973), Ph.D., *Instructor in Zoology*
Robert Taylor Cole (1935), Ph.D., *James B. Duke Research Professor of Political Science*
[11]Joel Colton (1947), Ph.D., *Professor of History*
Robert Merle Colver (1953), Ed.D., *Associate Professor of Education*
Anthony Conger (1973), Ph.D., *Visiting Associate Professor of Psychology*
Frank J. Convery (1972), Ph.D., *Assistant Professor of Forest Economics*
Philip J. Cook (1973), Ph.D., *Assistant Professor of Public Policy Sciences*
Samuel DuBois Cook (1966), Ph.D., LL.D., *Professor of Political Science*
Thomas Howard Cordle (1950), Ph.D., *Professor of Romance Languages*
Joseph M. Corless (1974), M.D., Ph.D., *Assistant Professor of Anatomy*
[12]Philip Robert Costanzo (1968), Ph.D., *Associate Professor of Psychology*
John D. Costlow, Jr. (1959), Ph.D., *Professor of Zoology*
Shelia J. Counce (1968), Ph.D., *Associate Professor of Anatomy*
[13]Dario Covi (1970), Ph.D., *Professor of Art*
Peter Cresswell (1974), Ph.D., *Assistant Professor of Immunology*
Herbert F. Crovitz (1963), Ph.D., *Lecturer in Psychology*
Alvin L. Crumbliss (1970), Ph.D., *Assistant Professor of Chemistry*
Chicita F. Culberson (1961), Ph.D., *Lecturer in Botany*
William Louis Culberson (1955), Ph.D., *Professor of Botany*
Ronald Y. Cusson (1970), Ph.D., *Associate Professor of Physics*
Robert Earle Cushman (1945), Ph.D., *Professor of Systematic Theology*
Jarir Dajani (1971), Ph.D., *Assistant Professor of Civil Engineering*
William W. Damon (1970), Ph.D., *Assistant Professor of Business Administration*
Charles Daniels (1970), M.D., Ph.D., *Assistant Professor of Pathology*
David G. Davies (1961), Ph.D., *Professor of Economics*
William D. Davies (1966), D.D., *George Washington Ivey Professor of Advanced Studies and Research in Christian Origins*
Calvin D. Davis (1962), Ph.D., *Associate Professor of History*
Gifford Davis (1930), Ph.D., *Professor of Romance Languages*
Lucy T. Davis (1969), Ed.D., *Associate Professor of Education*
Jeffrey R. Dawson (1969), Ph.D., *Assistant Professor of Immunology*
Eugene Davis Day (1962), Ph.D., *Professor of Immunology*
David C. Dellinger (1968), Ph.D., *Associate Professor of Business Administration*
Frank C. DeLucia (1969), Ph.D., *Assistant Professor of Physics*
Neil deMarchi (1971), Ph.D., *Assistant Professor of Economics*
A. Leigh DeNeef (1969), Ph.D., *Assistant Professor of English*
Irving T. Diamond (1958), Ph.D., *James B. Duke Professor of Psychology and Lecturer in Anatomy*
[14]Joseph Di Bona (1967), Ph.D., *Associate Professor of Education*
Arif Dirlik (1973), Ph.D., *Assistant Professor of History*
Frank C. Dorsey (1971), Ph.D., *Assistant Professor of Pathology*
Robert J. Drye, Jr. (1973), Ph.D., *Adjunct Assistant Professor of Civil Engineering*
[15]Bernard I. Duffey (1963), Ph.D., *Professor of English*

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[8]Leave of absence, academic year, 1974-75.
[9]Sabbatical leave, academic year, 1974-75.
[10]Sabbatical leave, academic year, 1974-75.
[11]Leave of absence, September 1, 1974 through August 31, 1976.
[12]Sabbatical leave, academic year, 1974-75.
[13]Leave of absence, academic year, 1974-75.
[14]Sabbatical leave, fall semester, 1974.
[15]Leave of absence, fall semester, 1974.

Kenneth Lindsay Duke (1940), Ph.D., *Associate Professor of Anatomy*
Robert F. Durden (1952), Ph.D., *Professor of History*
Jiri Dvorak (1967), C.Sc., Ph.D., *Professor of Civil Engineering*
Thomas G. Dzubay (1969), Ph.D., *Adjunct Assistant Professor of Physics*
Carol Eckerman (1973), Ph.D., *Assistant Professor of Psychology*
Jane G. Elchlepp (1960), M.D., Ph.D., *Associate Professor of Pathology*
Albert Eldridge (1970), Ph.D., *Assistant Professor of Political Science*
Howard L. Elford (1969), Ph.D., *Assistant Professor of Pharmacology*
Ernest Elsevier (1950), M.S., *Associate Professor of Mechanical Engineering*
Carl Erickson (1966), Ph.D., *Associate Professor of Psychology*
Harold P. Erickson (1970), Ph.D., *Assistant Professor of Anatomy*
[16]Robert P. Erickson (1961), Ph.D., *Professor of Psychology*
E. Harvey Estes (1953), M.D., *Professor of Public Policy Sciences*
Evan A. Evans (1973), Ph.D., *Assistant Professor of Biomedical Engineering*
Lawrence E. Evans (1963), Ph.D., *Associate Professor of Physics*
[17]John Wendell Everett (1932), Ph.D., *Professor of Anatomy*
Henry A. Fairbank (1962), Ph.D., *Professor of Physics*
John Morton Fein (1950), Ph.D., *Professor of Romance Languages*
Robert E. Fellows, Jr. (1966), M.D., Ph.D., *Associate Professor of Physiology*
Arthur Bowles Ferguson (1939), Ph.D., *Professor of History*
Lucy C. Ferguson (1974), Ph.D., *Visiting Professor of Psychology*
Oliver W. Ferguson (1957), Ph.D., *Professor of English*
Bernard F. Fetter (1951), M.D., *Professor of Pathology*
Gregory Warren Fischer (1973), Ph.D., *Assistant Professor of Psychology and Assistant Professor of Public Policy Sciences*
Peter G. Fish (1969), Ph.D., *Associate Professor of Political Science*
Joel Fleishman (1971), LL.M., *Professor of Law and Professor of Public Policy Sciences*
William H. Fletcher (1974), Ph.D., *Assistant Professor of Anatomy*
Anne Flowers (1972), Ed.D., *Professor of Education*
Donald J. Fluke (1958), Ph.D., *Professor of Zoology*
Lloyd R. Fortney (1964), Ph.D., *Associate Professor of Physics*
Richard B. Forward (1971), Ph.D., *Assistant Professor of Zoology*
Derrell Foster (1974), Ph.D., *Assistant Professor of Computer Science*
John A. Fowler (1953), M.D., *Lecturer in Education*
Wallace Fowlie (1964), Ph.D., *James B. Duke Professor of Romance Languages*
Richard G. Fox (1968), Ph.D., *Professor of Anthropology*
Ernestine Friedl (1973), Ph.D., *Professor of Anthropology*
Irwin Fridovich (1958), Ph.D., *Professor of Biochemistry*
William J. Furbish (1954), M.S., *Associate Professor of Geology*
Thomas M. Gallie, Jr. (1954-55; 1956), Ph.D., *Professor of Computer Science*
Miguel Garci-Gomez (1973), Ph.D., *Associate Professor of Romance Languages*
Devendra P. Garg (1972), Ph.D., *Professor of Mechanical Engineering*
[18]Raymond Gavins (1970), Ph.D., *Assistant Professor of History*
Ila Gehman (1959), Ed.D., *Lecturer in Psychology and Lecturer in Education*
W. Scott Gehman, Jr. (1954), Ph.D., *Professor of Psychology in Education*
Matthew Geller (1974), Ph.D., *Assistant Professor of Computer Science*
W. Doyle Gentry (1969), Ph.D., *Lecturer in Psychology*
Rhett Truesdale George, Jr. (1957), Ph.D., *Assistant Professor of Electrical Engineering*
Gerald E. Gerber (1962), Ph.D., *Associate Professor of English*
Susan Gerhart (1973), Ph.D., *Assistant Professor of Computer Science*
Robert G. Ghirardelli (1972), Ph.D., *Adjunct Associate Professor of Chemistry*
Nicholas W. Gillham (1968), Ph.D., *Professor of Zoology*
Sherwood Githens (1962), Ph.D., *Professor of Education*
[19]Craufurd Goodwin (1962), Ph.D., *James B. Duke Professor of Economics*
Lawrence C. Goodwyn (1971), Ph.D., *Adjunct Assistant Professor of History*
Walter Gordy (1946), Ph.D., LL.D., D.H.C., *James B. Duke Professor of Physics*
Alfred T. Goshaw (1973), Ph.D., *Assistant Professor of Physics*
Barry Gough (1974), Ph.D., *Visiting Associate Professor of History*
Henry Grabowski (1972), Ph.D., *Associate Professor of Economics*
Daniel A. Graham (1969), Ph.D., *Associate Professor of Economics*

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[16]Sabbatical leave, spring semester, 1975.
[17]Sabbatical leave, January 1, 1975 to June 30, 1975.
[18]Leave of absence, academic year, 1974-75.
[19]Leave of absence, half time, academic year, 1974-75.

Doyle G. Graham (1970), Ph.D., *Assistant Professor of Pathology*
Ronald C. Greene (1958), Ph.D., *Associate Professor of Biochemistry*
Joseph C. Greenfield (1962), M.D., *Assistant Professor of Physiology and Pharmacology*
John R. Gregg (1957), Ph.D., *Professor of Zoology*
Eugene Grueling (1948), Ph.D., *Professor of Physics*
Samson R. Gross (1960), Ph.D., *Professor of Genetics and Biochemistry*
Kazimierz Grzybowski (1967), S.J.D., *Professor of Political Science*
Walter R. Guild (1960), Ph.D., *Professor of Biophysics*
Robert Burns Gunn (1971), M.D., *Professor of Physiology*
John Gutknecht (1969), Ph.D., *Assistant Professor of Physiology and Pharmacology*
William F. Gutknecht (1971), Ph.D., *Assistant Professor of Chemistry*
[20]Norman Guttman (1951), Ph.D., *Professor of Psychology*
Robert L. Habig (1969), Ph.D., *Assistant Professor of Biochemistry*
Donald B. Hackel (1960), M.D., *Professor of Pathology*
Herbert Hacker, Jr. (1965), Ph.D., *Associate Professor of Electrical Engineering*
[21]Dwight H. Hall (1968), Ph.D., *Assistant Professor of Biochemistry*
Hugh Marshall Hall, Jr. (1952), Ph.D., *Professor of Political Science*
Louise Hall (1931), Ph.D., *Professor of Architecture*
William C. Hall (1970), Ph.D., *Assistant Professor of Anatomy and Associate Professor of Psychology*
John Hamilton Hallowell (1942), Ph.D., *Professor of Political Science*
William E. Hammond (1963), Ph.D., *Associate Professor of Biomedical Engineering*
[22]Moo-Young Han (1967), Ph.D., *Associate Professor of Physics*
[23]Philip Handler (1939), Ph.D., *James B. Duke Professor of Biochemistry and Nutrition*
Charles Morgan Harman (1961), Ph.D., *Professor of Mechanical Engineering*
Philip D. Harriman (1968), Ph.D., *Assistant Professor of Biochemistry*
Jerome S. Harris (1936), M.D., *Professor of Biochemistry*
Gerald Hartwig (1970), Ph.D., *Associate Professor of History*
Thomas M. Havrilesky (1969), Ph.D., *Associate Professor of Economics*
Hal K. Hawkins (1973), Ph.D., *Assistant Professor of Pathology*
Willis D. Hawley (1972), Ph.D., *Assistant Professor of Policy Sciences and Political Science*
Henry Hellmers (1965), Ph.D., *Professor of Botany and Professor of Forestry*
Robert William Henkens (1968), Ph.D., *Associate Professor of Chemistry*
Stuart C. Henry (1959), Ph.D., *Professor of American Christianity*
[24]Duncan Heron (1950), Ph.D., *Professor of Geology*
Frederick Herzog (1960), Th.D., *Professor of Systematic Theology*
Robert L. Hill (1961), Ph.D., *James B. Duke Professor of Biochemistry*
Charles Hirschman (1972), Ph.D., *Assistant Professor of Sociology*
George H. Hitchings (1971), Ph.D., *Adjunct Professor of Pharmacology*
[25]Marcus Edwin Hobbs (1935), Ph.D., *Professor of Chemistry*
Richard Earl Hodel (1965), Ph.D., *Associate Professor of Mathematics*
Charles S. Hodges, Jr. (1970), Ph.D., *Adjunct Associate Professor of Forest Pathology*
[26]Irving B. Holley, Jr. (1947), Ph.D., *Professor of History*
Frederic B. M. Hollyday (1956), Ph.D., *Professor of History*
Ole R. Holsti (1974), Ph.D., *George V. Allen Professor of Political Science*
Everett H. Hopkins (1961), M.A., LL.D., *Professor of Education*
Jerry F. Hough (1973), Ph.D., *Professor of Political Science and Professor of Public Policy Sciences*
James S. House (1970), Ph.D., *Assistant Professor of Sociology*
Frances Huemer (1974), Ph.D., *Visiting Professor of Art*
Alexander Hull (1962), Ph.D., *Associate Professor of Romance Languages*
[27]Allan S. Hurlburt (1956), Ph.D., *Professor of Education*
William L. Hylander (1971), Ph.D., *Associate Professor of Anatomy and Associate Professor of Anthropology*
Wallace Jackson (1965), Ph.D., *Associate Professor of English*
Boi Jon Jaeger (1971), Ph.D., *Associate Professor of Health Administration*

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[20]Sabbatical leave, fall semester, 1974.
[21]Leave of absence, academic year, 1974-75.
[22]Sabbatical leave, fall semester, 1974.
[23]Leave of absence, through June 30, 1979.
[24]Sabbatical leave, fall semester, 1974.
[25]Sabbatical leave, academic year, 1974-75.
[26]Leave of absence, academic year, 1974-75.
[27]Sabbatical leave, fall semester, 1974.

Hugo Jauregui (1970), M.D., Ph.D., *Assistant Professor of Pathology*
Peter W. Jeffs (1964), Ph.D., *Professor of Chemistry*
Marianna Jenkins (1948), Ph.D., *Professor of Art*
Bronislas de Leval Jezierski (1958), Ph.D., *Associate Professor of Slavic Languages and Literatures*
Frans F. Jöbsis (1964), Ph.D., *Professor of Physiology*
[28]Sheridan Johns, III (1970), Ph.D., *Associate Professor of Political Science*
Charles B. Johnson (1956), Ed.D., *Associate Professor of Education*
Edward A. Johnson (1963), M.D., *Professor of Physiology and Pharmacology*
Kurt E. Johnson (1971), Ph.D., *Assistant Professor of Anatomy*
Terry W. Johnson, Jr. (1954), Ph.D., *Professor of Botany*
William W. Johnston (1963), M.D., *Professor of Pathology*
William Thomas Joines (1966), Ph.D., *Associate Professor of Electrical Engineering*
Wolfgang Karl Joklik (1968), D.Phil., *James B. Duke Professor of Microbiology and Immunology*
Buford Jones (1962), Ph.D., *Associate Professor of English*
[29]Edward Ellsworth Jones (1953), Ph.D., *Professor of Psychology*
James Kalat (1971), Ph.D., *Assistant Professor of Psychology*
Henry Kamin (1948), Ph.D., *Professor of Biochemistry*
William G. Katzenmeyer (1967), Ed.D., *Associate Professor of Education*
Bernard Kaufman (1968), Ph.D., *Associate Professor of Biochemistry*
Richard F. Kay (1973), Ph.D., *Assistant Professor of Anatomy*
Thomas F. Keller (1959), Ph.D., *R. J. Reynolds Professor of Business Administration*
Allen C. Kelley (1972), Ph.D., *Professor of Economics*
[30]William N. Kelley (1968), M.D., *Assistant Professor of Biochemistry*
Van Leslie Kenyon, Jr. (1945), M.M.E., *Professor of Mechanical Engineering*
Alan C. Kerckhoff (1958), Ph.D., *Professor of Sociology*
Robert B. Kerr (1965), Ph.D., *Professor of Electrical Engineering*
Sung-Hou Kim (1970), Ph.D., *Associate Professor of Biochemistry*
Thomas DeArman Kinney (1960), M.D., *Professor of Pathology*
Gary Kirk (1970), Ph.D., *Assistant Professor of Physiology*
Norman Kirshner (1956), Ph.D., *Professor of Biochemistry*
[31]Joseph Weston Kitchen, Jr. (1962), Ph.D., *Associate Professor of Mathematics*
Gordon K. Klintworth (1964), M.D., Ph.D., *Professor of Pathology*
Peter H. Klopfer (1958), Ph.D., *Professor of Zoology*
Kenneth R. Knoerr (1961), Ph.D., *Professor of Forest Meteorology and Professor of Botany*
J. Mailen Kootsey (1969), Ph.D., *Assistant Professor of Physiology and Pharmacology*
Allen Kornberg (1965), Ph.D., *Professor of Political Science*
Wesley A. Kort (1965), Ph.D., *Associate Professor of Religion*
David Paul Kraines (1970), Ph.D., *Associate Professor of Mathematics*
Nicholas Michael Kredich (1968), M.D., *Assistant Professor of Biochemistry*
Irwin Kremen (1963), Ph.D., *Assistant Professor of Psychology*
[32]Juanita M. Kreps (1955), Ph.D., *James B. Duke Professor of Economics*
[33]William R. Krigbaum (1952), Ph.D., *James B. Duke Professor of Chemistry*
Magnus Jan Krynski (1966), Ph.D., *Associate Professor of Slavic Languages and Literature*
Arthur J. Kuhn (1971), Ph.D., *Assistant Professor of Business Administration*
Johannes A. Kylstra (1965), M.D., Ph.D., *Associate Professor of Physiology*
Weston LaBarre (1946), Ph.D., *James B. Duke Professor of Anthropology*
Leon Lack (1965), Ph.D., *Professor of Physiology and Pharmacology*
Creighton Lacy (1953), Ph.D., *Professor of Missions and Social Ethics*
[34]Martin Lakin (1958), Ph.D., *Professor of Psychology*
Richard L. Landeira (1970), Ph.D., *Assistant Professor of Romance Languages*
David J. Lang (1974), M.D., *Assistant Professor of Microbiology*
David L. Lange (1971), LL.B., *Professor of Public Policy Sciences*
Karla Langedijk (1969), Ph.D., *Lecturer in Art History*
Thomas A. Langford (1956), Ph.D., *Professor of Religion*
Peter K. Lauf (1968), M.D., *Associate Professor of Physiology and Assistant Professor of Immunology*

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[28]Leave of absence, academic year, 1974-75.
[29]Sabbatical leave, academic year, 1974-75.
[30]Leave of absence, September 1, 1974 through June 30, 1975.
[31]Sabbatical leave, fall semester, 1974.
[32]Sabbatical leave, fall semester, 1974.
[33]Sabbatical leave, fall semester, 1974.
[34]Leave of absence, academic year, 1974-75.

Dan J. Laughhunn (1968), Ph.D., *Professor of Business Administration and Management Sciences*
[35]Bruce B. Lawrence (1971), Ph.D., *Associate Professor of Religion*
Richard H. Leach (1955), Ph.D., *Professor of Political Science and Lecturer in Education*
Harold E. Lebovitz (1959), M.D., *Assistant Professor of Physiology*
Jack A. Lees (1971), Ph.D., *Assistant Professor of Mathematics*
Robert Lefkowitz (1973), Ph.D., *Assistant Professor of Biochemistry*
[36]Warren Lerner (1961), Ph.D., *Professor of History*
Alan S. Levy (1973), Ph.D., *Assistant Professor of Psychology*
Nelson Levy (1974), M.D., Ph.D., *Assistant Professor of Immunology*
Wilbur G. Lewellen (1974), Ph.D., *Visiting Professor of Business Administration*
Arie Y. Lewin (1974), Ph.D., *Professor of Business Administration*
Harold Walter Lewis (1946), Ph.D., *Professor of Physics*
Sara Lichtenstein (1974), Ph.D., *Assistant Professor of Art*
Melvyn Lieberman (1967), Ph.D., *Associate Professor of Physiology*
John L. Lievsay (1962), Ph.D., *James B. Duke Professor of English*
L. Sigfred Linderoth, Jr. (1965), M.E., *Professor of Mechanical Engineering*
Daniel A. Livingstone (1956), Ph.D., *Professor of Zoology*
Charles H. Lochmüller (1969), Ph.D., *Associate Professor of Chemistry*
Gregory Lockhead (1965), Ph.D., *Professor of Psychology*
Charles Houston Long (1974), Ph.D., *Professor of Religion*
William Longley (1968), Ph.D., *Associate Professor of Anatomy*
James S. Loos (1972), Ph.D., *Assistant Professor of Physics*
Donald Loveland (1973), Ph.D., *Professor of Computer Science*
John G. Lundberg (1970), Ph.D., *Assistant Professor of Zoology*
William S. Lynn, Jr. (1954), M.D., *Associate Professor of Biochemistry*
George W. Lynts (1965), Ph.D., *Associate Professor of Geology*
John Nelson Macduff (1956), M.M.E., *Professor of Mechanical Engineering*
Barry MacKichan (1970), Ph.D., *Assistant Professor of Mathematics*
Kenneth S. McCarty (1959), Ph.D., *Professor of Biochemistry*
David R. McClay (1973), Ph.D., *Assistant Professor of Zoology*
Carole Aldrich McCleery (1970), Ph.D., *Assistant Professor of Business Administration*
John B. McConahay (1974), Ph.D., *Associate Professor of Psychology*
Joe M. McCord (1970), Ph.D., *Associate Professor of Biochemistry*
Ralph C. McCoy (1973), M.D., *Assistant Professor of Pathology*
James H. McElhaney (1973), Ph.D., *Professor of Biomedical Engineering*
Marjorie McElroy (1970), Ph.D., *Assistant Professor of Economics*
Margaret A. McKean (1974), Ph.D., *Assistant Professor of Political Science*
Patrick A. McKee (1969), M.D., *Assistant Professor of Biochemistry*
John C. McKinney (1957), Ph.D., *Professor of Sociology*
Thomas J. McManus (1961), M.D., *Associate Professor of Physiology*
Andrew T. McPhail (1968), Ph.D., *Professor of Chemistry*
George L. Maddox (1960), Ph.D., *Professor of Sociology*
Wesley A. Magat (1974), Ph.D., *Assistant Professor of Business Administration*
M. Stephen Mahaley (1965), M.D., Ph.D., *Assistant Professor of Anatomy*
Edward P. Mahoney (1965), Ph.D., *Associate Professor of Philosophy*
Steven F. Maier (1971), Ph.D., *Assistant Professor of Business Administration*
Lazaro J. Mandel (1972), Ph.D., *Assistant Professor of Physiology*
Peter N. Marinos (1968), Ph.D., *Professor of Electrical Engineering and Professor of Computer Science*
Sidney David Markman (1947), Ph.D., *Professor of Art History and Archaeology*
David V. Martin (1962), Ed.D., *Associate Professor of Education*
Seymour Mauskopf (1964), Ph.D., *Associate Professor of History*
Robert Arthur Maxwell (1971), Ph.D., *Adjunct Professor of Pharmacology*
George Mayer (1974), Ph.D., *Adjunct Associate Professor of Mechanical Engineering*
Elgin W. Mellown, Jr. (1965), Ph.D., *Associate Professor of English*
Lorne Mendell (1968), Ph.D., *Associate Professor of Physiology*
Daniel B. Menzel (1971), Ph.D., *Associate Professor of Pharmacology*
Louis John Metz (1970), Ph.D., *Adjunct Associate Professor of Forest Soils*
Richard S. Metzgar (1962), Ph.D., *Professor of Immunology*
Johannes Horst Max Meyer (1959), D.Sc., *Professor of Physics*
Eric M. Meyers (1969), Ph.D., *Associate Professor of Religion*

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[35]Leave of absence, academic year, 1974-75.
[36]Sabbatical leave, academic year, 1974-75.

Martin Miller (1970), Ph.D., *Associate Professor of History*
Elliott Mills (1968), Ph.D., *Associate Professor of Physiology*
William Mishler (1972), Ph.D., *Assistant Professor of Political Science*
Gerald Monsman (1965), Ph.D., *Associate Professor of English*
John W. Moore (1961), Ph.D., *Professor of Physiology*
Lawrence C. Moore, Jr. (1966), Ph.D., *Associate Professor of Mathematics*
Wayne J. Morse (1974), Ph.D., *Associate Professor of Business Administration*
Montrose J. Moses (1959), Ph.D., *Professor of Anatomy*
Earl George Mueller (1945), Ph.D., *Professor of Art*
Bruce J. Muga (1967), Ph.D., *Professor of Civil Engineering*
Roland E. Murphy (1967-68; 1971), S.T.D., *Professor of Religion*
Francis Joseph Murray (1960), Ph.D., *Professor of Mathematics*
George C. Myers (1968), Ph.D., *Professor of Sociology*
Donald H. Namm (1974), Ph.D., *Adjunct Assistant Professor of Pharmacology*
Toshio Narahashi (1962-63; 1965), Ph.D., *Professor of Pharmacology*
Sydney Nathans (1966), Ph.D., *Associate Professor of History*
Aubrey Willard Naylor (1952), Ph.D., *James B. Duke Professor of Botany*
Thomas H. Naylor (1964), Ph.D., *Professor of Economics and Professor of Computer Science*
Glenn Robert Negley (1946), Ph.D., *Professor of Philosophy*
Henry Winston Newson (1948), Ph.D., *James B. Duke Professor of Physics*
Francis Newton (1967), Ph.D., *Professor of Latin in Classical Studies*
Charles Adam Nichol (1971), Ph.D., *Adjunct Professor of Pharmacology*
Jack L. Nichols (1970), Ph.D., *Associate Professor of Microbiology*
Robert Bruce Nicklas (1965), Ph.D., *Professor of Zoology*
Robert Niess (1971), Ph.D., *Professor of Romance Languages*
Loren Nolte (1966), Ph.D., *Professor of Electrical Engineering and Professor of Biomedical Engineering*
Thomas T. Norton (1972), Ph.D., *Assistant Professor of Psychology*
Richey Novak (1969), Ph.D., *Associate Professor of Germanic Languages*
Yasuhiko Nozaki (1962), Ph.D., *Associate in Biochemistry*
Holger O. Nygard (1960), Ph.D., *Professor of English*
John F. Oates (1967), Ph.D., *Professor of Ancient History in Classical Studies*
Jean F. O'Barr (1970), Ph.D., *Lecturer in Political Science*
William O'Barr (1969), Ph.D., *Associate Professor of Anthropology*
Walter D. Obrist (1956), Ph.D., *Lecturer in Psychology*
William M. O'Fallon (1965), Ph.D., *Assistant Professor of Mathematics*
Robert T. Osborn (1954), Ph.D., *Professor of Religion*
Ronald W. Oppenheim (1973), Ph.D., *Lecturer in Psychology*
Suydam Osterhout (1959), M.D., Ph.D., *Professor of Microbiology*
Athos Ottolenghi (1959), M.D., *Associate Professor of Physiology and Pharmacology*
Harry Ashton Owen, Jr. (1951), Ph.D., *Professor of Electrical Engineering*
George M. Padilla (1965), Ph.D., *Associate Professor of Physiology*
David L. Paletz (1967), Ph.D., *Associate Professor of Political Science*
Aubrey E. Palmer (1944), C.E., *Associate Professor of Civil Engineering*
Richard A. Palmer (1966), Ph.D., *Associate Professor of Chemistry*
Erdman B. Palmore (1967), Ph.D., *Professor of Sociology*
William E. Parham (1972), Ph.D., *R. J. Reynolds Industries Professor of Chemistry*
Harold Talbot Parker (1939), Ph.D., *Professor of History*
Harry B. Partin (1964), Ph.D., *Associate Professor of Religion*
Merrell Lee Patrick (1964), Ph.D., *Associate Professor of Computer Science*
William Bernard Peach (1951), Ph.D., *Professor of Philosophy*
[37]George Wilbur Pearsall (1964), Sc.D., *Professor of Mechanical Engineering*
Talmage Lee Peele (1939), M.D., *Professor of Anatomy and Lecturer in Psychology*
Ronald D. Perkins (1968), Ph.D., *Associate Professor of Geology*
David W. Peterson (1973), Ph.D., *Professor of Business Administration*
Olan Lee Petty (1952), Ph.D., *Professor of Education*
[38]Leland R. Phelps (1961), Ph.D., *Professor of German*
Jane Philpott (1951), Ph.D., *Professor of Botany and Professor of Forestry*
Orrin Pilkey (1965), Ph.D., *Professor of Geology*
Theo Clyde Pilkington (1958), Ph.D., *Professor of Biomedical Engineering and Professor of Electrical Engineering*
Colin G. Pitt (1969), Ph.D., *Adjunct Associate Professor of Chemistry*

[37]Sabbatical leave, fall semester, 1974.
[38]Sabbatical leave, academic year, 1974-75.

Robert A. Pittillo, Jr. (1968), Ed.D., *Associate Professor of Education*
Jacques C. Poirier (1955), Ph.D., *Professor of Chemistry*
Ned Allen Porter (1969), Ph.D., *Associate Professor of Chemistry*
Herbert S. Posner (1968), Ph.D., *Clinical Associate Professor of Pharmacology*
William H. Poteat (1960), Ph.D., *Professor of Christianity and Culture*
Philip Pratt (1966), M.D., *Professor of Pathology*
Richard Lionel Predmore (1950), D.M.L., *Professor of Romance Languages*
Jack J. Preiss (1959), Ph.D., *Professor of Sociology*
Richard A. Preston (1961), Ph.D., *William K. Boyd Professor of History*
David Eugene Price (1973), Ph.D., *Associate Professor of Political Science and Associate Professor of Public Policy Sciences*
James Ligon Price, Jr. (1952), Ph.D., *Professor of Religion*
Louis DuBose Quin (1956), Ph.D., *Professor of Chemistry*
Naomi Quinn (1972), Ph.D., *Assistant Professor of Anthropology*
James Rachels (1974), Ph.D., *Visiting Associate Professor of Philosophy*
Jill Raitt (1973), Ph.D., *Associate Professor of Religion*
R. Rajagopal (1974), Ph.D., *Assistant Professor of Forestry*
K. V. Rajagopalan (1966), Ph.D., *Associate Professor of Biochemistry*
Charles William Ralston (1954), Ph.D., *Professor of Forest Soils*
Dietolf Ramm (1969), Ph.D., *Assistant Professor of Computer Science*
Dale B. J. Randall (1957), Ph.D., *Professor of English*
Normal B. Ratliff (1968), M.D., *Associate Professor of Pathology*
Michael Charles Reed (1974), Ph.D., *Professor of Mathematics*
Michael Kay Reedy (1969), M.D., *Associate Professor of Anatomy*
Edmund Reiss (1967), Ph.D., *Professor of English*
Jacqueline A. Reynolds (1969), Ph.D., *Associate Professor of Anatomy and Associate Professor of Biochemistry*
David Claude Richardson (1969), Ph.D., *Assistant Professor of Biochemistry*
Lawrence Richardson, Jr. (1966), Ph.D., *Professor of Latin in Classical Studies*
Eberhard Karl Riedel (1971), Ph.D., *Associate Professor of Physics*
Kent J. Rigsby (1971), Harvard Society of Fellows, *Assistant Professor of Classics*
Nathan Russell Roberson (1963), Ph.D., *Professor of Physics*
George W. Roberts (1971), Ph.D., *Associate Professor of Philosophy*
Verne Louis Roberts (1973), Ph.D., *Adjunct Professor of Mechanical Engineering*
J. David Robertson (1966), M.D., Ph.D., *Professor of Anatomy*
[39]Charles K. Robinson (1961), Ph.D., *Associate Professor of Religion*
George Robinson (1971), Ph.D., *Assistant Professor of Psychology*
Hugh G. Robinson (1964), Ph.D., *Professor of Physics*
Hermann R. Robl (1959-64; 1966), Ph.D., *Adjunct Professor of Physics*
Theodore Ropp (1938), Ph.D., *Professor of History*
Carl M. Rose, Jr. (1967), Ph.D., *Assistant Professor of Physics*
Gerald Martin Rosen (1972), Ph.D., *Assistant Professor of Physiology and Pharmacology*
Lawrence Rosen (1974), Ph.D., *Associate Professor of Anthropology*
David Rosenthal (1969), Ph.D., *Adjunct Associate Professor of Chemistry*
Myron Rosenthal (1969), Ph.D., *Assistant Professor of Physiology*
David J. Ross (1972), Ph.D., *Assistant Professor of Philosophy*
[40]Wendell F. Rosse (1966), M.D., *Associate Professor of Immunology*
Susan Roth (1973), Ph.D., *Assistant Professor of Psychology*
Donald Francis Roy (1950), Ph.D., *Professor of Sociology*
Clyde de Loache Ryals (1973), Ph.D., *Professor of English*
Harvey J. Sage (1964), Ph.D., *Associate Professor of Biochemistry and Assistant Professor of Pathology*
Lester M. Salamon (1973), Ph.D., *Assistant Professor of Political Science and Assistant Professor of Public Policy Science*
Herman Salinger (1955), Ph.D., *Professor of Germanic Languages and Comparative Literature*
John V. Salzano (1956), Ph.D., *Associate Professor of Physiology*
[41]David H. Sanford (1970), Ph.D., *Associate Professor of Philosophy*
Lloyd Saville (1946), Ph.D., *Professor of Economics*
Saul M. Schanberg (1967), M.D., Ph.D., *Professor of Pharmacology*
Knut Schmidt-Nielsen (1952), Mag.Sc., Dr.Phil., *James B. Duke Professor of Comparative Physiology in the Department of Zoology*

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[39]Sabbatical leave, fall semester, 1974.
[40]Leave of absence, July 1, 1974 through December 31, 1974.
[41]Sabbatical leave, academic year, 1974-75.

Harold Schiffman (1963), Ph.D., *Professor of Psychology*
Eugene S. Schneller (1973), Ph.D., *Assistant Professor of Sociology*
David W. Schomberg (1968), Ph.D., *Assistant Professor of Physiology*
James M. Schooler, Jr. (1970), Ph.D., *Assistant Professor of Physiology*
Anne Firor Scott (1961), Ph.D., *Professor of History*
David W. Scott (1971), Ph.D., *Assistant Professor of Immunology*
William E. Scott (1958), Ph.D., *Professor of History*
Richard A. Scoville (1961), Ph.D., *Associate Professor of Mathematics*
Richard B. Searles (1965), Ph.D., *Associate Professor of Botany*
Hillard Foster Seigler (1967), M.D., *Associate Professor of Immunology*
John Shelburne (1973), Ph.D., *Assistant Professor of Pathology*
Marion L. Shepard (1967), Ph.D., *Associate Professor of Mechanical Engineering*
Joseph R. Shoenfield (1952), Ph.D., *Professor of Mathematics*
R. Baird Shuman (1962), Ph.D., *Professor of Education*
Lewis M. Siegel (1966), Ph.D., *Associate Professor of Biochemistry*
[42]Bernard Silberman (1967), Ph.D., *Professor of History*
Ida Harper Simpson (1967), Ph.D., *Associate Professor of Sociology*
Theodore Alan Slotkin (1971), Ph.D., *Assistant Professor of Physiology*
Carol A. Smith (1974), Ph.D., *Assistant Professor of Anthropology*
D. Moody Smith (1965), Ph.D., *Professor of New Testament Interpretation*
David A. Smith (1962), Ph.D., *Associate Professor of Mathematics*
Donald S. Smith, II (1959), M.H.A., *Assistant Professor of Health Administration*
Grover C. Smith (1952), Ph.D., *Professor of English*
Harmon L. Smith (1959), Ph.D., *Professor of Moral Theology*
Joel Smith (1958), Ph.D., *Professor of Sociology*
Peter Smith (1959), Ph.D., *Professor of Chemistry*
Ralph Smith (1970), Ph.D., *Assistant Professor of Microbiology*
Ralph Snyderman (1974), M.D., *Assistant Professor of Immunology*
George G. Somjen (1963), M.D., *Professor of Physiology and Lecturer in Psychology*
Joachim R. Sommer (1957), M.D., *Associate Professor of Pathology*
Bernard F. Spielvogel (1972), Ph.D., *Adjunct Associate Professor of Chemistry*
Thomas Arthur Spragens, Jr. (1967), Ph.D., *Assistant Professor of Political Science*
Olaf Stackelberg (1963), Ph.D., *Associate Professor of Mathematics*
John E. R. Staddon (1967), Ph.D., *Professor of Psychology*
William J. Stambaugh (1961), Ph.D., *Professor of Forest Pathology*
Dennis Keith Stanley (1961), Ph.D., *Associate Professor of Classical Studies*
Charles Franklin Starmer, Jr. (1966), Ph.D., *Associate Professor of Computer Science*
Howard Steinman (1970), Ph.D., *Associate Professor of Biochemistry*
David Curtis Steinmetz (1971), Th.D., *Associate Professor of Religion*
Henry R. Stern (1968), Ph.D., *Assistant Professor of Germanic Languages and Literature*
Philip Stewart (1972), Ph.D., *Associate Professor of Romance Languages*
Deborah Stone (1974), Ph.D., *Lecturer in Public Policy Sciences and Lecturer in Political Science*
Donald E. Stone (1963), Ph.D., *Professor of Botany*
Kenneth B. Storey (1974), Ph.D., *Assistant Professor of Biochemistry and Comparative Physiology in the Department of Zoology*
Boyd R. Strain (1969), Ph.D., *Associate Professor of Botany*
Victor H. Strandberg (1966), Ph.D., *Associate Professor of English*
Timothy Lee Strickler (1973), Ph.D., *Assistant Professor of Anatomy*
Howard Austin Strobel (1948), Ph.D., *Professor of Chemistry*
Arthur L. Sullivan (1974), Ph.D., *Assistant Professor of Forestry*
J. Bolling Sullivan (1970), Ph.D., *Assistant Professor of Biochemistry*
Elizabeth Read Sunderland (1939-42; 1943), Ph.D., *Professor of Art*
John Sutherland (1969), Ph.D., *Assistant Professor of Zoology*
Charles Tanford (1959), Ph.D., *James B. Duke Professor of Physical Biochemistry*
Robert Taylor (1974), Ph.D., *Assistant Professor of Business Administration*
John J. TePaske (1967), Ph.D., *Professor of History*
Marcel Tetel (1960), Ph.D., *Professor of Romance Languages*
[43]Frederick L. Thurstone (1967), Ph.D., *Professor of Biomedical Engineering and Professor of Electrical Engineering*
Edward A. Tiryakian (1965), Ph.D., *Professor of Sociology*
Craig Tisher (1969), M.D., *Associate Professor of Pathology*

[42]Sabbatical leave, academic year, 1974-75.
[43]Sabbatical leave, academic year, 1974-75.

Daniel C. Tosteson (1961), M.D., *James B. Duke Professor of Physiology*
Edward Tower (1974), Ph.D., *Associate Professor of Economics*
Vladimir G. Treml (1967), Ph.D., *Professor of Economics*
Richard J. Trilling (1970), Ph.D., *Assistant Professor of Political Science*
Vance Tucker (1964), Ph.D., *Professor of Zoology*
Arlin Turner (1953), Ph.D., *James B. Duke Professor of English*
Richard L. Tuthill (1953), Ed.D., *Professor of Economic Geography*
Lee E. Tyrey (1970), Ph.D., *Assistant Professor of Anatomy*
Senol Utku (1970), Sc.D., *Professor of Civil Engineering*
[44]Arturo Valenzuela (1970), Ph.D., *Assistant Professor of Political Science*
Thomas C. Vanaman (1970), Ph.D., *Associate Professor of Microbiology*
James H. Vander Weide (1972), Ph.D., *Assistant Professor of Business Administration*
[45]John M. Vernon (1966), Ph.D., *Professor of Economics*
Aleksander Sedmak Vesić (1964), D.Sc., *J. A. Jones Professor of Civil Engineering*
P. Aarne Vesilind (1970), Ph.D., *Associate Professor of Civil Engineering*
Elia E. Villanueva (1961), M.A., *Associate Professor of Physical Therapy*
[46]Patrick R. Vincent (1954), Ph.D., *Associate Professor of Romance Languages*
F. Stephen Vogel (1961), M.D., *Professor of Pathology*
[47]Steven Vogel (1966), Ph.D., *Associate Professor of Zoology*
Olaf T. von Ramm (1974), Ph.D., *Assistant Professor of Biomedical Engineering*
Fred M. Vukovich (1967), Ph.D., *Adjunct Associate Professor of Forest Meteorology*
[48]Howard C. Wachtel (1968), Ph.D., *Associate Professor of Biomedical Engineering and Assistant Professor of Physiology*
Stephen A. Wainwright (1964), Ph.D., *Associate Professor of Zoology*
William D. Walker (1971), Ph.D., *Professor of Physics*
Andrew G. Wallace (1971), Ph.D., *Assistant Professor of Physiology*
Thomas Dudley Wallace (1974), Ph.D., *Professor of Economics*
Lise Wallach (1970), Ph.D., *Lecturer in Psychology*
Michael Wallach (1962), Ph.D., *Professor of Psychology*
Richard L. Walter (1962), Ph.D., *Professor of Physics*
[49]Paul P. Wang (1968), Ph.D., *Associate Professor of Electrical Engineering*
Calvin L. Ward (1952), Ph.D., *Associate Professor of Zoology*
Frances Ellen Ward (1969), Ph.D., *Associate Professor of Immunology*
Bruce W. Wardropper (1962), Ph.D., *William Hanes Wannamaker Professor of Romance Languages*
Dennis B. Warner (1973), Ph.D., *Assistant Professor of Civil Engineering*
Seth L. Warner (1955), Ph.D., *Professor of Mathematics*
Richard Lyness Watson, Jr. (1939), Ph.D., *Professor of History*
Katherine Way (1968), Ph.D., *Adjunct Professor of Physics*
Robert E. Webster (1970), Ph.D., *Associate Professor of Biochemistry*
Eliot Roy Weintraub (1970), Ph.D., *Associate Professor of Economics*
Morris Weisfeld (1967), Ph.D., *Professor of Mathematics*
Henry Weitz (1950), Ed.D., *Professor of Education*
Richard L. Wells (1962), Ph.D., *Professor of Chemistry*
Paul Welsh (1948), Ph.D., *Professor of Philosophy*
Robert W. Wheat (1956), Ph.D., *Professor of Microbiology and Assistant Professor of Biochemistry*
Charles W. White (1970), Ph.D., *Assistant Professor of Psychology*
Richard A. White (1963), Ph.D., *Professor of Botany*
[50]Henry M. Wilbur (1973), Ph.D., *Assistant Professor of Zoology*
Karl Milton Wilbur (1946), Ph.D., *James B. Duke Professor of Zoology*
Robert L. Wilbur (1957), Ph.D., *Professor of Botany*
Pelham Wilder, Jr. (1949), Ph.D., *Professor of Chemistry*
Hilda Pope Willett (1948), Ph.D., *Professor of Microbiology and Immunology*
George W. Williams (1957), Ph.D., *Professor of English*
Leland Williams (1970), Ph.D., *Adjunct Associate Professor of Computer Science*
William Hailey Willis (1963), Ph.D., *Professor of Greek in Classical Studies*

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[44]Leave of absence, fall semester, 1974.
[45]Sabbatical leave, academic year, 1974-75.
[46]Sabbatical leave, spring semester, 1975.
[47]Sabbatical leave, spring semester, 1975.
[48]Sabbatical leave, academic year, 1974-75.
[49]Sabbatical leave, academic year, 1974-75.
[50]Sabbatical leave, spring semester, 1975.

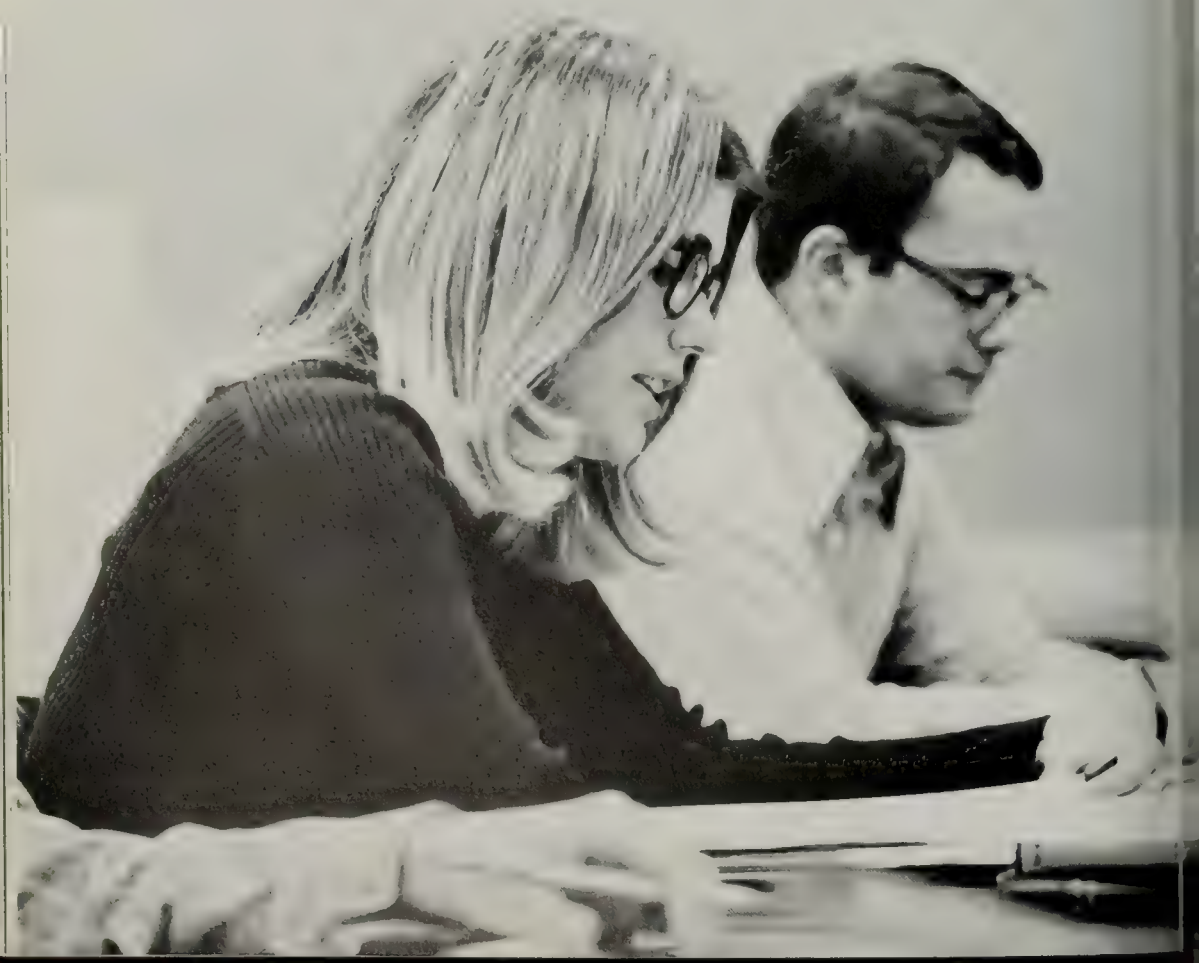
[51]James F. Wilson (1967), Ph.D., *Associate Professor of Civil Engineering*
James W. Wilson (1967), M.D., Ph.D., *Assistant Professor of Pathology*
John Wilson (1968), Ph.D., *Associate Professor of Sociology*
Thomas George Wilson (1959), Sc.D., *Professor of Electrical Engineering*
Cliff W. Wing, Jr. (1965), Ph.D., *Professor of Psychology*
Orval S. Wintermute (1958), Ph.D., *Associate Professor of Religion*
Ronald Witt (1971), Ph.D., *Associate Professor of History*
Benjamin Wittels (1961), M.D., *Professor of Pathology*
Myron L. Wolbarsht (1968), Ph.D., *Adjunct Professor of Biomedical Engineering, Adjunct Professor of Physiology, and Lecturer in Psychology*
Max A. Woodbury (1966), Ph.D., *Professor of Computer Science*
Donald Wright (1967), Ph.D., *Associate Professor of Mechanical Engineering*
James E. Wuenscher (1970), Ph.D., *Assistant Professor of Forest Ecology*
Allen M. Wyse (1974), Ph.D., *Assistant Professor of Economics*
David O. Yandle (1967), Ph.D., *Associate Professor of Forest Mathematics*
William P. Yohe (1958), Ph.D., *Professor of Economics*
[52]Charles R. Young (1954), Ph.D., *Professor of History*
Franklin W. Young (1944-50; 1968), Ph.D., *Amos Ragan Kearns Professor of New Testament and Patristic Studies in Religion*
Julie H. Zalkind (1973), Ph.D., *Assistant Professor of Business Administration*
Peter Zwadyk (1971), Ph.D., *Assistant Professor of Pathology*
Hans J. Zweerink (1970), Ph.D., *Associate Professor of Microbiology*

Emeritus Professors

Katharine May Banham (1946), Ph.D., *Professor Emeritus of Psychology*
Charles A. Baylis (1952), Ph.D., *Professor Emeritus of Philosophy*
Joseph W. Beard (1937), M.D., *James B. Duke Professor Emeritus of Virology*
Mary L. C. Bernheim (1930), Ph.D., *Professor Emeritus of Biochemistry*
Lucius Aurelius Bigelow (1929), Ph.D., *Professor Emeritus of Chemistry*
Edward Claude Bolmeier (1948), Ph.D., *Professor Emeritus of Education*
Francis Ezra Bowman (1945), Ph.D., *Professor Emeritus of English*
Benjamin Boyce (1950), Ph.D., *James B. Duke Professor Emeritus of English*
Frances Campbell Brown (1931), Ph.D., *Professor Emeritus of Chemistry*
Benjamin Guy Childs (1924), M.A., *Professor Emeritus of Education*
Kenneth Willis Clark (1931), Ph.D., D.D., *Professor Emeritus of New Testament*
Norman Francis Conant (1935), Ph.D., *James B. Duke Professor Emeritus of Microbiology*
Frederick A. G. Cowper (1918), Ph.D., *Professor Emeritus of Romance Languages*
John S. Curtiss (1945), Ph.D., *James B. Duke Professor Emeritus of History*
Bingham Dai (1943), Ph.D., *Professor Emeritus of Psychology*
Frank Traver deVyver (1935), Ph.D., *Professor Emeritus of Economics*
Neal Dow (1934), Ph.D., *Professor Emeritus of Romance Languages*
Francis George Dressel (1929), Ph.D., *Professor Emeritus of Mathematics*
George Sharp Eadie (1930), Ph.D., *Professor Emeritus of Physiology and Pharmacology*
Howard Easley (1930), Ph.D., *Associate Professor Emeritus of Education*
William Whitfield Elliott (1925), Ph.D., *Professor Emeritus of Mathematics*
Allan H. Gilbert (1920), Ph.D., *Professor Emeritus of English*
Clarence Gohdes (1930), Ph.D., *James B. Duke Professor Emeritus of English*
Irving Emery Gray (1930), Ph.D., *Professor Emeritus of Zoology*
Paul M. Gross (1919), Ph.D., *William Howell Pegram Professor Emeritus of Chemistry*
Frank A. Hanna (1948), Ph.D., *Professor Emeritus of Economics*
Ellwood Scott Harrar (1936), Ph.D., *James B. Duke Professor Emeritus of Wood Science*
Charles Cleveland Hatley (1917), Ph.D., *Professor Emeritus of Physics*
William S. Heckscher (1966), Ph.D., *Benjamin N. Duke Professor Emeritus of Art*
Jay Broadus Hubbell (1927), Ph.D., *Professor Emeritus of English*
Wanda S. Hunter (1947), Ph.D., *Professor Emeritus of Zoology*
William H. Irving (1936), B.A. (Oxon.), Ph.D., *Professor Emeritus of English*
Brady Rimbey Jordan (1927), Ph.D., *Professor Emeritus of Romance Languages*
Helen L. Kaiser (1943), R.P.T., *Professor Emeritus of Physical Therapy*
Paul Jackson Kramer (1931), Ph.D., *James B. Duke Professor Emeritus of Botany*
Wladyslaw W. Kulski (1963), Dr. Jur., *James B. Duke Professor Emeritus of Russian Affairs*
William Thomas Laprade (1909), Ph.D., *Professor Emeritus of History*

[51]Sabbatical leave, spring semester, 1975.
[52]Sabbatical leave, academic year, 1974-75.

Charles Earl Landon (1926), Ph.D., *Professor Emeritus of Economics*
John Tate Lanning (1927), Ph.D., *James B. Duke Professor Emeritus of History*
Alan Krebs Manchester (1929), Ph.D., *Professor Emeritus of History*
Walter McKinley Nielsen (1925), Ph.D., *James B. Duke Professor Emeritus of Physics*
James G. Osborne (1961), B.S., *Professor Emeritus of Forestry*
Robert Leet Patterson (1945), Ph.D., *Professor Emeritus of Philosophy*
Lewis Patton (1926), Ph.D., *Professor Emeritus of English*
Michael I. Pavlov (1960), Ph.D., *Associate Professor Emeritus of Slavic Languages*
Harold Sanford Perry (1932), Ph.D., *Professor Emeritus of Botany*
Ray C. Petry (1937), Ph.D., LL.D., *James B. Duke Professor Emeritus of Church History*
Robert Stanley Rankin (1927), Ph.D., *Professor Emeritus of Political Science*
Mabel F. Rudisill (1948), Ph.D., *Professor Emeritus of Education*
Charles Richard Sanders (1937), Ph.D., *Professor Emeritus of English*
William H. Simpson (1930), Ph.D., *Professor Emeritus of Political Science*
David Tillerson Smith (1930), M.D., Litt.D., *James B. Duke Professor Emeritus of Microbiology*
H. Shelton Smith (1931), Ph.D., *James B. Duke Professor Emeritus of Religion*
Joseph John Spengler (1934), Ph.D., *James B. Duke Professor Emeritus of Economics*
William Franklin Stinespring (1936), Ph.D., *Professor Emeritus of Old Testament and Semitics*
W. A. Stumpf (1948), Ph.D., *Professor Emeritus of Education*
Edgar Tristram Thompson (1935), Ph.D., *Professor Emeritus of Sociology*
James Nardin Truesdale (1930), Ph.D., *Professor Emeritus of Greek*
Clement Vollmer (1926), Ph.D., *Professor Emeritus of German*
Warren Chase Vosburgh (1928), Ph.D., *Professor Emeritus of Chemistry*
Loring Baker Walton (1929), Lic. es L., Ph.D., *Professor Emeritus of Romance Languages*
Charles Eugene Ward (1927), Ph.D., *Professor Emeritus of English*
Bruce A. Wells (1964), M.S.E.E., *Associate Professor Emeritus of Electrical Engineering*
Robert Renbert Wilson (1925), Ph.D., LL.D., *James B. Duke Professor Emeritus of Political Science*
Frederick Adolphus Wolf (1927), Ph.D., *James B. Duke Professor Emeritus of Botany*
Robert Hilliard Woody (1929), Ph.D., *Professor Emeritus of History*

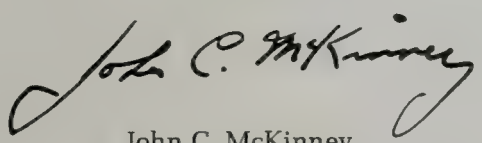


To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

> The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.
>
> Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.



John C. McKinney
Dean of the Graduate School



Program Information



Degrees Offered

The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Health Administration (M.H.A.), Master of Business Administration (M.B.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.).

The Master's Degrees

To be considered as a candidate for a master's degree (A.M., M.S., M.Ed., M.A.T., M.H.A., M.B.A.), the graduate student must (1) have made passing grades in the first 12 units of course work, (2) have made a grade of *G* or *E* on at least 3 units of this work, and (3) have received the approval of the major department (or in the case of the M.A.T. degree of the supervisory committee).

Residence Requirements. Candidates for all master's degrees must spend, as a *minimum*, one full academic year (two successive semesters), or its equivalent in summer session terms, in residence at Duke University. Candidates who wish to complete their degrees wholly in the summer session must be in residence for a minimum of five summer terms. Additional time is frequently necessary. Three terms are held each summer. (See section on Residence under Academic Regulations.)

Transfer of Graduate Credits. A maximum of 6 units of graduate credit may be transferred for graduate courses completed at other institutions. Such units will be transferred only if the student has received a grade of *B* (or its equivalent) or better. *In any case, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.* A student who wishes to transfer up to 6 units into his program must register at Duke for units equivalent to the number he is transferring. Request for tranfer should be submitted on the approved graduate school form (T1).

A student who is granted such transfer credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units. As another option, he may take as many as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level. In no case will credit be allowed for extension or correspondence courses.

Credit for graduate courses taken at Duke by a student (not undergraduate) before his admission to the Graduate School or while registered as a nondegree

student may be carried over into a graduate degree program if: (1) the action is recommended by the director of graduate studies of the department and approved by the dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of *G* level or better.

Time Limits for Completion of Master's Degrees. The master's degree candidate who is in residence for consecutive academic years should complete all requirements for the degree *within two calendar years* from the date of his first registration in the Graduate School. Any candidate must complete all requirements *within six calendar years of his first registration.*

To be awarded a degree in May, the student must have completed all requirements, including the recording of transfer credit, by the last day of the final examination period. If a thesis is one of the requirements, it must be submitted to the Graduate School Office no later than April 15. Candidates desiring to have their degrees conferred on September 1 must have completed all requirements as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree conferred at the following May Graduation Exercises. (Transfer of credit for work completed at other universities must be recorded by September 1.)

The Thesis. The thesis should demonstrate the student's ability to collect, arrange, interpret, and report pertinent material on a research problem. Although a publishable document is not required, the thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures. Requirements of form are set forth in the Duke University *Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School Office.

Recommendation for Teacher Certification. An elementary school teacher who already holds a certificate and who desires the recommendation of Duke University for a graduate teaching certificate must include in his program a minimum of 12 units in subjects ordinarily taught in elementary school and 12 units in education courses appropriate to his professional development. A secondary school teacher must include in his program a minimum of 18 units in his teaching field and 6 units in courses in education appropriate to his professional development.

MASTER OF ARTS

The Master of Arts degree may be earned either with or without presentation of a thesis. Whether or not a student writes a thesis, however, certain general requirements must be met.

Prerequisites. As prerequisites to graduate study in his major subject, the student must have completed a minimum of 24 semester hours—ordinarily 12 semester hours of approved college courses in that subject and 12 additional semester hours in that subject or in related work. Since some departments require more than 12 semester hours in the proposed field of study, the student should read carefully the special requirements listed by his major department, described in the departmental course section in this *Bulletin*. If special master's degree requirements are not specified in this section, a prospective student should write directly to the appropriate director of graduate studies.

Language Requirements. The Graduate School requires no foreign language for the master's degree. Certain departments, however, do have a foreign language requirement for their master's programs. Any such requirement must

be satisfied before the master's examination is taken. (See the departmental sections in the chapter on courses of instruction and the chapter on registration and regulations.)

Major and Related Subjects. The student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in the major subject. A minimum of 6 units must be in a minor subject or related fields which are approved by the student's major department. The remaining 6 units of the required 24 may be taken in either the major or in related fields approved by the major department and by the Dean of the Graduate School. A maximum of 6 units may be earned either by submission of an approved thesis, or by completing courses or other academic activities approved by the student's department. (See below.) Thirty units of graduate credit at Duke constitutes minimum enrollment for the Master of Arts degree.

Completing the Program with Thesis. All basic requirements for preparing the thesis are described in the *Guide for the Preparation of Theses and Dissertations*, available in the Graduate School Office.

Four typewritten copies of the thesis bound in snap binders which may be secured through the Graduate School Office must be submitted in an approved form to the Dean of the Graduate School on or before April 15 for a May degree, or August 15 for a September degree, and at least one week before the scheduled date of the final examination. The copies will then be distributed by the student to the several members of the examining committee. Two copies for the library and one copy for the adviser will be bound upon payment of $5 per volume. Additional copies may be bound at the $5 per volume rate.

Completing the Program without Thesis. Individual departments decide the options with which a Master of Arts degree may be completed without presentation of a thesis. The student's committee usually outlines the requirements for a degree program after the student has completed at least 9 units of graded course work. Beyond the 24 units required in major or related course work, 6 units may be earned either through course work or through other academic activities approved by the student's department and committee. Such academic exercises might include an additional 3 units of graded course work complemented, for example, by the following: (1) passing an oral examination on a three- to five-page research prospectus, plus a substantial bibliography on a topic within the student's major field, or (2) submission to the committee of two carefully revised term papers, preferably written originally for different instructors and originally earning a grade of G or higher. In any case, the student's total minimum registration will be for 30 units of graduate credit followed by a final examination (see below).

The Examining Committee and the Examination. The faculty member who directs the student's program recommends an examining committee composed of himself and two other members of the graduate faculty, one of whom usually must be from a department other than the major department. If the student has been permitted to take related work within the major department, the third member may be chosen from within the department. Nominations for membership on this committee are submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

The student's committee will conduct the examination and certify his success or failure by signing the card provided by the Graduate School Office. This card indicates completion of all requirements for the degree. If a thesis is presented, the committee also signs all copies of the thesis, and the candidate

then returns the original, the first two copies, and any other copies he wishes bound to the Graduate School.

Filing the Intention to Graduate. On or *before February 1 for a May* degree or on or *before August 1 for a September* degree, and at least one month prior to his final examination, the student must file in the Office of the Graduate School, on the official form, a declaration of intention to graduate. The declaration of intention presents the title of the thesis or specifies the alternative academic exercises on which the degree candidate will be examined. The declaration must have the approval of both the director of graduate studies in the major department and the chairman of the student's advisory committee.

MASTER OF SCIENCE

The degree of Master of Science is offered in various areas, including the following: botany, forestry, geology, management sciences, pathology, physical therapy, statistics and computing, and four fields of engineering—biomedical, civil, electrical, and mechanical.

Prerequisites. A bachelor's degree is a prerequisite for the M.S. degree. Departments offering an M.S. degree consider for admission students from allied fields provided they have satisfactory scientific and mathematical backgrounds.

Language Requirement. There is no foreign language requirement in Master of Science degree programs.

Other Degree Requirements. Specific requirements vary according to the department. Please consult the section on Courses of Instruction for departmental information concerning prerequisites, minimum units required, and major and related work.

Thesis and Examination. Some departments require a thesis; all departments require an examination. The regulations and options for theses and other means of completing the program, as well as the provisions for examination and examining committee, are the same as the requirements for the Master of Arts degree discussed in the previous section.

MASTER OF EDUCATION

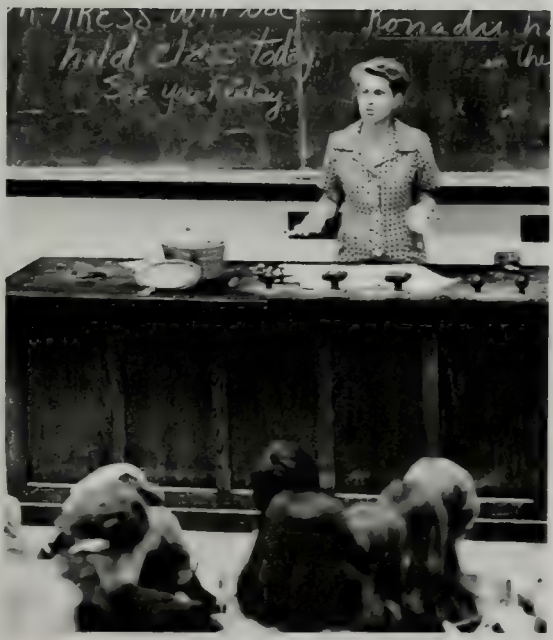
Prerequisites. The M.Ed. degree is designed for persons intending to pursue a career in professional education. No specific undergraduate major is required for acceptance into a graduate program leading to this degree, but the student must have earned a bachelor's degree and pursued an undergraduate program related to his professional goals.

Before the degree is conferred, the student must have completed one year of experience in professional education or have included in his program 6 units of practicum, internship, and/or field experience or have met certification requirements by supervised student teaching in an accredited school.

Major and Related Subjects. The student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in a departmental major (administration, supervision, counseling, elementary education, secondary education, higher education, reading, teaching the emotionally disturbed, or other approved programs offered by the department). A minimum of 6 units must be in a minor subject or related areas within the Department of Education. The remaining 6 units of the required 24 may be







taken in either the major or in related subjects. The nature of the additional 6 units for which the student must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., the additional 6 units may be earned either by submitting an acceptable thesis or by completing courses in major and related subjects. A minimum of 30 units of earned credit is required for the degree.

Completing the Program with Thesis. The regulations governing the thesis are the same as those for the A.M. degree.

Completing the Program without Thesis. No sooner than the end of the term in which the student completes his course work, he must pass a comprehensive examination on his departmental major. The examinations shall be prepared and conducted by members of the faculty as designated by the Director of Graduate Studies of the Department of Education.

MASTER OF ARTS IN TEACHING

Prerequisites. The M.A.T. degree is designed for teachers already in service and for recent graduates of liberal arts colleges who wish to teach in a public school, private school, or junior college.

A student ordinarily should have completed a minimum of 12 semester hours in his proposed major subject and an additional 12 semester hours in related subjects. Should a student wish to undertake a graduate major different from his undergraduate major, the prerequisites may be modified upon the recommendation of the student's committee and the approval of the Dean of the Graduate School.

Degree Programs. Either of two programs may be arranged in consultation with the student's committee.

1. For students seeking certification: a major of 18 to 24 units in education and 12 to 18 units in non-education courses, a total of 36 units. A maximum of 6 units of the 36 units required under this option may be 100-level or undergraduate education courses. A grade of *B* or better must be earned in any undergraduate course included in the 36 unit requirement.
2. For students already certified: a major in non-education courses of 18 to 24 units and 6 to 12 units in education, a total of 30 units.

The non-education courses are to be taken in one or more subjects usually taught in the secondary schools. The quantity and departmental distribution of this work will be determined by the needs of the individual student. A combined major in biological sciences or in physical sciences is possible in this program. Teachers who have already completed certification requirements must major in a teaching field in their Master of Arts in Teaching program. Students who have completed certification requirements must major in education.

The Master of Arts in Teaching degree may be earned with or without the presentation of a thesis. If a student, in consultation with his committee, elects to present a thesis, 6 units of the total of 30 or 36 units required may be granted for thesis research. The regulations governing the thesis are the same as those for the A.M. degree *with thesis*.

The Committee. Each candidate for the degree will be assigned a committee, appointed by the director of graduate studies in the major department or area. This committee will consist of three members, at least one of whom will be from the Department of Education, and at least one from another department. Usually the chairman of the committee will be chosen from the department of the major.

MASTER OF HEALTH ADMINISTRATION

The Department of Health Administration offers a curriculum for graduate students interested in the field of health services management. It is designed primarily for students who hope to assume major leadership roles in a variety of organizations and programs that involve the provision of health services in public or private settings.

The Master of Health Administration program is designed around a core of courses in health services and management sciences, with electives in behavioral sciences. The student selects one of four concentrations for in-depth study: finance, personnel, planning, or information management. The academic program is five semesters in length. Upon completing the degree, the student usually undertakes a 12-month rotating residency during which he

receives a salary. (Students with prior experience may petition for a waiver of the residency.)

Students with any undergraduate major may apply. One year of calculus at the college level is the only prerequisite, and a special course is available each summer for students whose preparation in mathematics is inadequate or out of date.

MASTER OF BUSINESS ADMINISTRATION

Prerequisites. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and courses preparatory to rigorous analysis. Undergraduate majors in physical and biological sciences, mathematics, engineering, and social sciences usually are well suited for the program. The M.B.A. program is designed to provide a foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

Degree Program. The M.B.A. program contains a prescribed core of courses dealing with tools of analysis and the fundamental theoretical foundations for administrative practice. Each candidate elects additional courses to prepare more specifically for his particular field.

The M.B.A. requires four semesters of full-time work totaling 64 units of graduate course credit. (See the Business Administration section under Courses of Instruction for a more detailed description of degree requirements.) The M.B.A. program has neither a language nor a thesis requirement. No formal minor subject is required. A project in administrative research and formal writing is required in the fourth semester and is described as the practicum in the list of courses.

The Doctoral Degrees

Transfer of Credit. Up to 30 units of graduate credit in which a grade of *G* (or its equivalent) or better was earned may be accepted by transfer only after the student has earned at least 12 units of graduate credit at Duke. Such transfer of credit must be on the recommendation of the chairman of the student's advisory committee and the director of graduate studies of the student's major department. (Graduate school form T1 should be used to request transfer of credit.)

Credit for graduate courses taken at Duke by a student (not undergraduate) before his admission to the Graduate School or while registered as a nondegree student may be carried over into a graduate degree program if: (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of *G* level or better.

DOCTOR OF PHILOSOPHY

The Ph.D. degree is a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. degree is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

Requirements. The formal requirements for the Ph.D. degree are as

follows: (1) major and related courses, (2) foreign language(s) in most departments, (3) a supervisory committee for program of study, (4) residence, (5) preliminary examination, (6) dissertation, and (7) final examination. In order to be considered for candidacy for the Ph.D. degree, the student must have passing grades in all course work and a grade of *G* or better on at least 9 units of this course work.

Foreign Languages. The language requirements for the Doctor of Philosophy degree vary among departments. Some departments do not require a language, some require two languages, others require a specific language. A prospective student should request information from the appropriate director of graduate studies, if no such requirement is described under the departmental heading in this *Bulletin*. (For methods of meeting the requirement, see Language Requirements.)

A student working toward the doctoral degree should complete any language requirement set by his department by the end of his first year of residence. If he fails to meet the requirement by the end of his third semester of residence, he should register in the appropriate special reading course or courses. Any foreign language requirement must be met before the preliminary examination is taken.

Major and Related Work. The student's program of study demands substantial concentration on courses in his major department. However, a minimum of 6 units in a related field approved by his major department must be included. A few programs have been authorized by the Executive Committee of the Graduate Faculty to utilize courses in fields within the major department in fulfilling the related field requirement.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and *not later than two months before the preliminary examination* the director of graduate studies in the major department will nominate for the approval of the dean a supervising committee consisting of five members with one member designated as chairman. This committee will include at least three graduate faculty members of the major department and, usually, at least one from outside the department. For programs in which approval has been granted for related work from a clearly differentiated division within the department, one member of the committee will be chosen from that division. In this circumstance all members of the supervisory committee will be from the same department. This committee, with all members participating, will determine a program of study and administer the preliminary examination. Successful completion of the final examination requires four affirmative votes. The final examination may be administered by four members, if the representative of the related field is present.

Residence. The *minimum* registration requirement is 60 units of graduate credit, of which not more than 30 units may be accepted by transfer. Since a full program is 30 units per academic year, the prospective Ph.D. candidate who enters with the A.B. or B.S. degree must plan to spend in residence a *minimum* of two academic years; if he enters with the A.M. degree, his *minimum* residence is one academic year. (For the definition of *residence*, see the section on residence in the chapter on Academic Regulations.) Each student must register for a full program until he passes the preliminary examination. If there are undergraduate deficiencies in his program, he may be required to take preliminary undergraduate courses for which he will not receive degree credit. Even if there are no such undergraduate deficiencies, the student's super-

visory committee will determine what requirements above the minimum, if any, the student must meet.

Credit for Summer Work. Credit earned in the summer session will not reduce the minimum required residence. (See the section on the summer session.)

Time Limitations. Courses, language certifications, or other credits for advanced standing which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

Ordinarily the student should pass the preliminary examination by the end of the third year of graduate study. If he has not passed the examination by the end of the third year of full-time registration, he must file with the Dean of the Graduate School a statement, approved by the director of graduate studies in his major department, explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the middle of the fourth year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the Dean of the Graduate School for an extension of up to one year. If this extension is granted and the dissertation is not submitted and accepted by the new deadline, the student must pass a second preliminary examination to remain a candidate for the degree. In such a case, the time limit for submitting the dissertation will be determined by the Dean of the Graduate School and the candidate's committee.

In cases of particular merit, and with the approval of the Dean of the Graduate School, departments may extend the limits of the total elapsed time within which credit will be allowed for courses, the language examinations, and the preliminary examination. The graduate faculty of the departments will have these limits in mind when a student is considered for admission or readmission to the Ph.D. program, for approval to take the preliminary examination, and for approval to submit the dissertation and take the final examination. In instances of excessive elapsed time, revalidation of credits may be required. Responsibility for requiring such revalidation lies with the department. Proposed requirements for revalidation require the approval of the Dean of the Graduate School.

Preliminary Examination. A student is not accepted as a candidate for the Ph.D. degree until he has passed his preliminary examination at Duke. The examination ordinarily covers both the major field and related work. In the summer, a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Privilege of Reexamination. Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and of the Dean of the Graduate School, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all committee members. Failure on the second examination will render the student ineligible to continue his program for the Ph.D. degree at Duke University.

Reduction in Registration. The student who passes the preliminary examination is eligible for a reduction in required registration. He should arrange with the Graduate School Office the change in registration he desires.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

One month before the dissertation is presented and no later than February 1 (February 2 if February 1 falls on Sunday) preceding the May commencement at which the degree is expected to be conferred, the student must file with the Dean of the Graduate School, on the official form available at the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation (type of paper, form, and binding) are prescribed in the *Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School Office.

The dissertation must be completed to the satisfaction of the professor who directs it. Four typewritten copies bound in snap binders which may be secured through the Graduate School Office must be deposited with the Dean of the Graduate School on or before *April 1* preceding the May commencement at which the degree is to be conferred. The dissertation must be submitted to the Graduate School Office at least seven days before the scheduled date of the student's examination.

All doctoral dissertations are published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may copyright them, if they wish. Abstracts are published in *Dissertation Abstracts International*.

In brief, all copies of the dissertation, the original in clean type, will remain in spring binders until after the final examination. Three extra copies of the abstract (not more than 600 words long) are submitted when the dissertation is first presented to the Graduate School Office. A nonreturnable fee of $25.00 is charged for microfilming. If copyright is desired, an additional fee of $15.00 is charged. The original and two copies will be bound at a cost of $5.00 per volume. The student may request that more than three copies be so bound. If more than one snap binder is required per copy of the dissertation, a deposit of $3.50 will be collected for each additional snap binder.

Final Examination. The final oral examination shall be primarily on the dissertation. However, questions may be asked in the candidate's major field. Except in unusual circumstances, approved by the Dean, a final examination will not be scheduled when school is not in session.

If a student fails his final examination, he may be allowed to take it a second time, but no sooner than six months from the date of his first examination. Permission to take the second examination must be obtained from the professor who directed the dissertation and from the Dean of the Graduate School. Failure to pass the second examination renders the student ineligible to continue work for the Ph.D. degree at Duke University.

Deposit of the Dissertation. After passing the examination, the candidate brings to the Graduate School Office the original and the first two copies of the dissertation, properly signed, as well as other copies he wishes bound. At this time he signs the microfilming agreement and pays microfilming and copyright fees.

DOCTOR OF EDUCATION

The Ed.D. degree is a professional degree for those who are, or intend to become, high level professional personnel in the field of education. The student will choose one of the following as his area of concentration: (a) ad-

ministration, (b) supervision, (c) counseling, (d) curriculum and instruction, (e) education of emotionally disturbed, (f) higher education, (g) reading, or (h) school psychology.

To be considered as a candidate for the Ed.D. degree, the student must have earned passing grades in the first 30 units of course work and a grade of G or better on 24 units of this course work.

Major and Related Work. The minimum registration requirement is 60 units of graduate credit, of which not more than 18 units may be in research or accepted by transfer. (Transfer credits which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted.) The student's program must include at least 30 units of course work in his area of concentration and 12 units in related areas.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable, and not later than two months before the preliminary examination, the Director of Graduate Studies will nominate for the approval of the Dean a supervising committee of five graduate faculty members, with one member designated as chairman. One or more members must represent the student's minor field. The committee will determine a program of study, administer the preliminary examination, and, with such changes as are approved by the Dean, administer the final doctoral examination.

Experience. Prior to receiving the Ed.D. degree, the student must have at least two years of experience in professional education.

The program of study must include a minimum of 6 units in practicum, internship, and/or field experience under the direction of one or more faculty members.

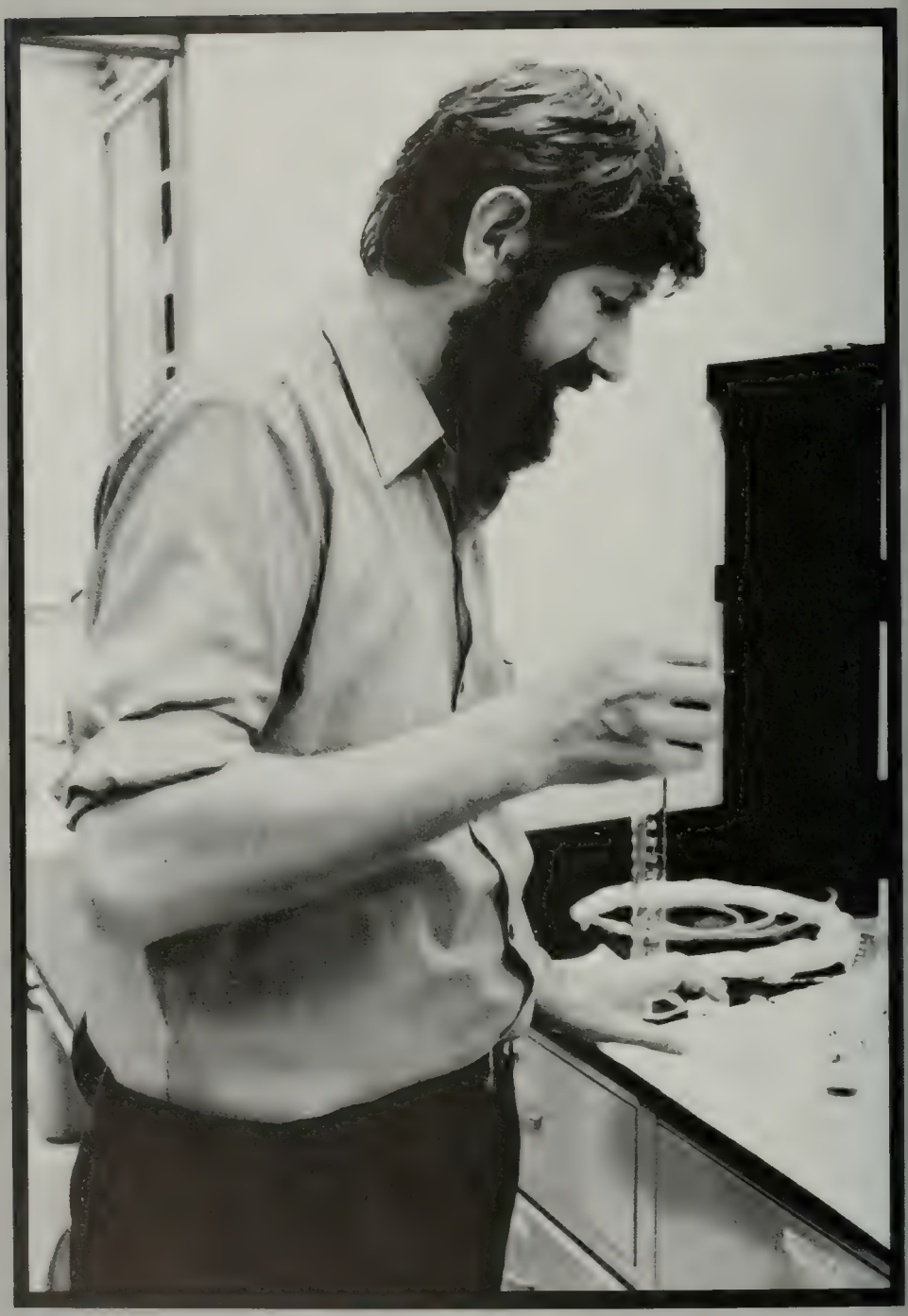
Time Limitations. The student ordinarily should pass the preliminary examination by the end of his sixth year of graduate study at Duke. If he has not passed it by this time, he must file a statement endorsed by the director of graduate studies with the Dean of the Graduate School explaining the delay and setting a date for the examination.

Preliminary Examination. A student is not accepted as a candidate for the Ed.D. degree until he has passed the preliminary examination. The examination covers both the major field and related work and is taken during or shortly after the term in which the approved program of course work is completed.

Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the Dean of the Graduate School, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all members of the committee. Failure on the second examination will render the student ineligible to continue his program in the Department of Education at Duke University.

Dissertation. The dissertation is expected to be a mature and competent piece of writing which demonstrates the student's ability to collect, arrange, analyze, evaluate, interpret, and report pertinent material in his area of concentration. This may embody the results of applied research in the form of a major project or model (for example: in-service education plans for a school system, computer programs, curriculum guides, instructional materials) or the results of significant and original research.

Procedural regulations governing the Ed.D. dissertation and final examination are identical to those for the Ph.D. degree.



Special and Cooperative Programs



Center for the Study of Aging and Human Development

The primary aims of the center have been to encourage and support fundamental research concerned with the processes and health problems of aging, to train investigators for research on aging, and to develop a source of scientific knowledge in the field of aging for governmental agencies as well as for private groups and individuals.

The center conducts a multidisciplinary two-year program for predoctoral or postdoctoral fellows interested in research training in some aspect of the behavioral sciences and psychophysiology in aging and adult development. Through faculty seminars and independent work, fellows are able to select and concentrate on various aspects of the human life cycle. Methods, specialized skills, and individual research are stressed. Resources of this all-University program located in the Medical Center include on-going longitudinal studies and a variety of biomedical, psychophysiological, and psychological laboratories and social scientific research programs. Access to the faculties of medicine and of arts and sciences is facilitated by a tradition of multidisciplinary research and a central location. Inquiries should be addressed to the Training Director, Center for the Study of Aging and Human Development, Duke University Medical Center, Durham, North Carolina 27710.

Canadian Studies Program

The Canadian Studies Program was inaugurated in September, 1973, with the aid of grants from the William H. Donner Foundation and the Office of Education of the United States Department of Health, Education and Welfare for the purpose of formalizing and expanding the Duke Graduate School's interest in Canada, of introducing the study of Canadian life and culture at the undergraduate level, and of encouraging such study in primary and secondary schools. The program's basic aim is to increase American knowledge and understanding of Canada.

The program awards graduate fellowship for the study of Canada by American residents in the Departments of History, Political Science, Sociology, and Economics. Grants of travel aid for field research in Canada are also offered, and some teaching assistantships are given.

The program also sponsors lectures by Canadian specialists and cooperates with the Center for Commonwealth Studies in sponsoring the Commonwealth joint seminar on Canadian topics.

Publications arising from research on Canada may be published in the Commonwealth Studies Series.

Inquiries should be addressed to the Director of Canadian Studies, Center for International Studies, 2101 Campus Drive, Duke University, Durham, North Carolina 27706.

Center for Commonwealth Studies

The Center for Commonwealth Studies was established at Duke University in 1955 and has received financial support from the Carnegie Corporation of New York, the Rockefeller Foundation, and the Ford Foundation. Its objectives are:

1. To encourage and stimulate the research interests of individual scholars in Commonwealth affairs, European institutions and their expansion, and development studies.

2. To establish at Duke University a center to promote interest in research relating to the Commonwealth, provide the materials for basic research, and encourage research by Commonwealth and American students and faculty.

The center awards fellowships to graduate students from Australia, Canada, and New Zealand who propose to study toward the Ph.D. degree in economics, history, or political science at Duke University. National selection committees in each of these countries facilitate the selection of fellows.

Each spring the center sponsors a joint seminar for graduate students in economics, history, and political science. The objective of this seminar is to encourage a broad approach to developments within the Commonwealth. The center also sponsors lectures at the University by distinguished Commonwealth scholars.

Studies resulting from research sponsored by the center are frequently published by the Duke University Press in the Commonwealth Studies Series, now numbering forty-two volumes. Inquiries should be addressed to the Director, Center for Commonwealth Studies, Duke University, Durham, North Carolina 27706.

Program in Comparative Studies on Southern Asia

The Program in Comparative Studies on Southern Asia was established at Duke University in 1961 under a grant from the Ford Foundation to the Center for Commonwealth Studies. In 1963 the University entered into a contract with the United States Office of Education to sponsor a South Asian Language Training and Area Center under the provisions of Title VI of the National Defense Act. The basic purpose of this program is twofold: to facilitate research on the political, historical, economic, and sociocultural development of Commonwealth countries in Southern Asia (India, Pakistan, Shri Lanka, Malaysia, and Singapore), and to provide for the systematic training of graduate students in anthropology, economics, education, history, political science, religion, and sociology, with special emphasis on the area.

The graduate student, in addition to meeting the requirements of the department in which he is enrolled, is expected to take Hindi-Urdu or another major South Asian language, related courses in other departments, and to undertake field research in the preparation of his dissertation.

Each year the program awards a limited number of predoctoral fellow-

ships under the conditions specified above. Awards with similar requirements are also made under the NDEA Title VI language fellowships offered by the United States Office of Education.

Facilitation and support of research activities by members of the Duke University faculty and graduate students are important aspects of the program's activities. Research grants for faculty and students are also available from the American Institute of Indian Studies and the United States Office of Education. Research facilities include those materials received as a result of the University's participation in a library acquisitions program under the terms of Public Law 480.

The program has undertaken the publication of three series: hardcover monographs, reprints of articles of note dealing with the Southern Asian region, and a series of occasional papers. It also brings visiting Asian scholars to the campus for lectures and symposia, and co-sponsors forums and research activities with the Carolina Population Center of the University of North Carolina, the Southern Atlantic States Association for South Asian Studies, and the Association of Asian Studies.

Inquiries should be addressed to the Administrative Assistant, Program in Comparative Studies on Southern Asia, Duke University, Durham, North Carolina 27706.

Cooperative Program in Teacher Education

Program in Secondary Education for the M.A.T. Degree. Selected graduates of liberal arts colleges who have not completed a teacher preparation program will be admitted to the Cooperative Program in Teacher Education to complete their requirements for a teacher's certificate and to pursue additional training in the proposed teaching field. Full-year internships with salary are arranged with cooperating public and private school systems. Students admitted to this program are required to attend the first summer session before their internship. This program is limited to students preparing to teach biology, English, mathematics, and social studies in junior and senior high schools. For materials describing this program, write to the Graduate School, 127 Allen Building, or to Director, Cooperative Program in Teacher Education, Department of Education, West Duke Building, Durham, North Carolina 27708.

Cooperative Programs with Neighboring Universities

Interchange of Registration. (See Registration, the Reciprocal Agreements with Neighboring Universities.)

Library Exchange. Through a cooperative lending program graduate students of the University of North Carolina and Duke University are granted loan privileges in both universities.

Cooperative Program in Russian and East European History. The graduate schools of Duke University and the University of North Carolina offer a cooperative program leading to the A.M. and Ph.D. degrees in several disciplines (economics, history, literature, linguistics, political science, sociology), with a concentration in Russian and East European Studies. Students admitted to one institution are encouraged to enroll in courses at the other institution which are advantageous to their programs, and to utilize the libraries and facilities of both universities. The holdings of the two libraries in Russian and East European materials are substantial and complementary. Both libraries

have a policy of purchasing all significant published works in Slavic history, economics, government, geography, literature, and linguistics. Other joint activities include a monthly colloquium involving the personnel of the two institutions and distinguished visiting scholars.

A special project of the Duke program has been the assemblage of an outstanding collection of Soviet underground (*Samizdat*) literature (including letters and manuscripts) which is widely exhibited by the Committee.

A research program in Soviet economics (input-output analysis) provides special training for graduate students in this field and publishes a series of monographs under the auspices of a Ford Foundation grant.

Center for Demographic Studies

A Population Studies Program was established at Duke University in 1963 to promote research and training in demography and human ecology. The program was renamed as the Center for Demographic Studies in 1972 in recognition of its broad multidisciplinary focus and expanded research programs. The facilities of the center include a population library, extensive data bank sources, and equipment for automated data processing. These are available to the entire Duke community.

Training under the auspices of the center leads to a Ph.D. degree within either the Department of Sociology or the Department of Economics. Although degrees are awarded through either department, the program is designed to provide an integrated cross-disciplinary training in the common specialty area of population studies. The bearing of sociological and economic theory upon the analysis of demographic phenomena is emphasized, and participation in active research projects is afforded center trainees.

In addition to course and research opportunities, which are open to any interested graduate students in the University, a weekly non-credit seminar meets throughout the academic year for presentations by students, staff, and visiting guest lecturers.

Graduate Fellowships for students in the training program are available. Inquiries may be directed to Dr. George C. Myers, Director, Center for Demographic Studies, Box 4732, Duke Station, Duke University, Durham, North Carolina 27706.

Duke Environmental Center

Environmental and ecological programs exist in several departments and schools at Duke University, including botany, engineering, forestry, medicine, and zoology. In order to provide better coordination among these programs and to stimulate further teaching and research in environmental subjects, the Duke Environmental Center was formed in January, 1972.

The purposes of the Duke Environmental Center are to focus attention on pressing environmental problems, to provide orientation and educational opportunities in environmental subjects for both students and faculty, to promote interdisciplinary environmental research, and to serve as a point of contact for University and environmental agencies and the public. The center does not offer degrees, but allows students and faculty to emphasize the environmental aspects of their studies and research by becoming affiliated with the center while remaining in their established departments and professional schools. The center sponsors a visiting speakers program, graduate and faculty seminars, and graduate and undergraduate courses in environmental studies.



A reference room containing books, periodicals, and research papers on environmental subjects is open to students, faculty, and the public in room 107A Biological Sciences Building. Information on environmental programs and courses offered at Duke and other Research Triangle institutions and on internships and opportunities in environmental careers may be obtained by writing or visiting the Environmental Center Office, 118 School of Engineering, Duke University, Durham, North Carolina 27706.

The University Program in Genetics.

The University Program in Genetics was established to provide for the coherent development of instruction and research in genetics throughout the University. The faculty of the program consists of scientists holding primary appointments in the various biological science departments. They have developed an interdepartmental graduate curriculum designed to meet the needs of students with a variety of educational backgrounds and professional objectives. Students in any of the science departments may specialize in genetics under the auspices of the interdisciplinary University Program in Genetics.

For current information consult Professor S. R. Gross, 151 Nanaline H. Duke Building, Duke University, Durham, North Carolina 27710.

Hispanic Studies Program

The Graduate School offers an interdepartmental program of Hispanic studies leading to the A.M. and Ph.D. degrees. Students may write their theses and take their degrees in history, economics, political science, sociology, or Hispanic languages and literatures. The purpose of the program is to provide a desirable combination of courses on the Hispanic world in these disciplines and to give candidates more rigorous training in Hispanic studies. In consultation with the candidate, a faculty committee will determine a special program of study.

The holdings of the Duke University Library for graduate work and research in Hispanic American history, inter-American relations, economic history, politics, art, and Spanish American literature are constantly being enlarged.

Materials-Fields-Mechanics Research Program

The Graduate School offers an interdisciplinary program in materials research leading to the M.S. and Ph.D. degrees. Students write their theses and take their degrees in one of the engineering departments but have access to the resources of an interdepartmental faculty, comprising the Materials Research Group. The purpose of the program is to encourage and facilitate research on the interactions of materials with various fields (stress, thermal, electromagnetic, fluid, etc.).

Requests for information about specific research areas available may be obtained through the directors of graduate studies in biomedical, civil, electrical, and mechanical engineering.

Medical Scientist Training Program

The Medical Scientist Training Program, conducted under the auspices of the Graduate School and the School of Medicine, is designed for students with a strong background in science who are motivated toward a career in the medical sciences and academic medicine. It provides an opportunity to integrate graduate education in one of the sciences basic to medicine with the clinical curriculum of the School of Medicine. The program requires six to seven years of study and leads to both the M.D. and Ph.D. degrees. Although the special emphasis of this program is on basic medical science, the trainees, because of their education in clinical medicine, have a remarkable range of career opportunities open to them. Graduates of this program generally follow one of two broad paths. Some directly pursue careers in teaching and research in one of the basic medical sciences, while maintaining strong ties with clinical science as a result of their combined training; others enter residency programs before pursuing investigative and teaching careers in clinical medicine, carrying with them strong academic backgrounds in the basic sciences.

Eligibility. Applicants must meet the admission requirements of both the Graduate School as a candidate for the Ph.D. degree and the Medical School as a candidate for the M.D. degree. Most candidates apply for admission to the first year of the program, but applications are accepted from students who are in residence in the Graduate School or Medical School of Duke University. In addition to the minimum requirements for acceptance in the Graduate School and the Medical School, advanced course work in science and mathematics as well as prior research experience counts heavily in the selection of candidates.

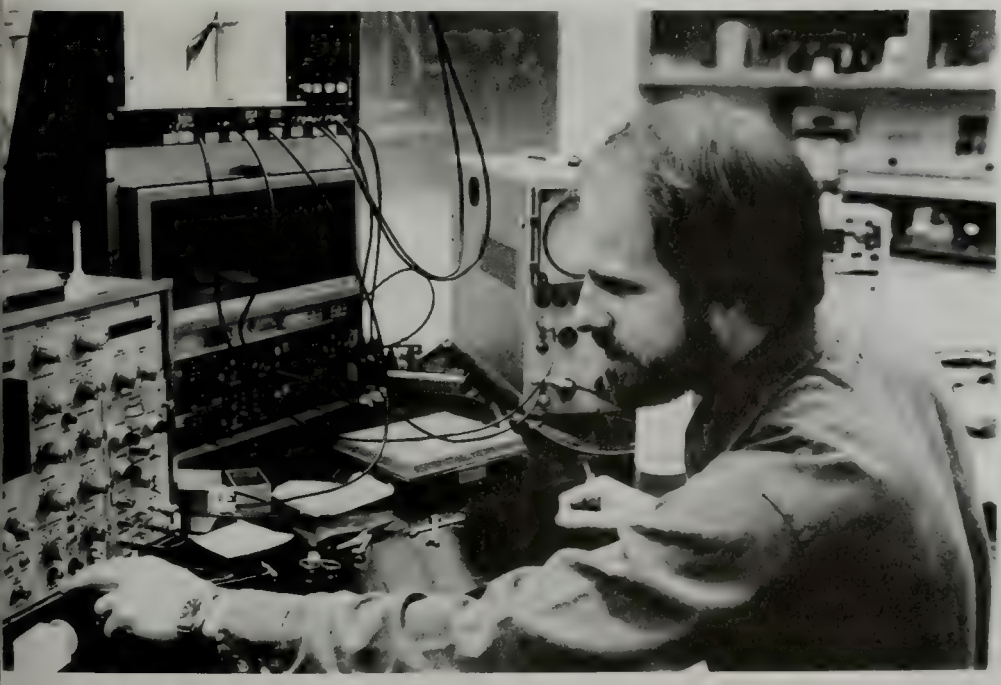
Financial Support. Students admitted to the first year of the program in 1975 will receive a traineeship award, consisting of a stipend and full tuition allowance, provided by a grant from the National Institutes of Health. The annual stipend is $3,000 plus $600 per dependent for the first four years of the program and $5,000 plus $600 per dependent in subsequent years. Support will be continued until the trainee has completed both degrees, provided progress remains satisfactory.

The Training Program. This program has been designed to offer trainees latitude in the selection of course material. Basic requirements are two academic years composed of the first basic science year and the second clinical science year of the curriculum for medical students at Duke University. Following completion of the second year, the trainee enters the graduate program to complete the requirements for the Ph.D. degree. A final academic year of elective clinical study is necessary to complete the requirements for the M.D. degree. Both degrees are awarded at the completion of this sequence.

Additional information may be obtained by writing Robert E. Fellows, M.D., Ph.D., Associate Director, Medical Scientist Training Program, Box 3709, Duke University Medical Center, Durham, North Carolina 27710.

The Medical Historian Training Program

The Medical Historian Training Program is conducted under the auspices of the School of Medicine and the Graduate School to provide professionally trained medical historians. A minimum of six years of graduate study is required. Upon satisfactory completion of the program, the M.D. and Ph.D. degrees will be awarded. It is anticipated that graduates will undertake a minimum of one year of postgraduate medical training, following which their major effort will be in teaching and scholarly activities in the field of the history of medicine. They also may have minor clinical responsibilities.



Basic requirements are two academic years in the School of Medicine consisting of "core" basic sciences in the first year, ending with the course Introduction to Clinical Medicine, and "core" clinical sciences during the second year, following which the student enters the Department of History in the Graduate School.

Candidates for the Ph.D. degree in history devote approximately two full years to completion of their required courses, work in seminars, and preparatory study for preliminary or qualifying examinations. The actual length of time needed to earn the Ph.D. degree depends upon the number of years beyond the two years candidates find necessary for researching and writing dissertations. Candidates will pursue studies in the Department of History during the third and fourth academic years of the program. In the fifth and sixth years, the student should have one year in which to pursue medical-historical research and one year of elective courses in the School of Medicine to fulfill the requirements for the M.D. degree.

Application and Admission Procedures. Applicants must meet the requirements for admission to the School of Medicine and the Graduate School in the Department of History. Candidates who have completed two years of medical school will also be considered.

In addition to the minimum requirements established by the School of Medicine and the Graduate School, courses in history and the history and philosophy of science will count heavily in the selection of candidates.

Applicants should complete and submit an application to the Graduate School for admission to the Department of History.

Additional information may be obtained by writing to Gert H. Brieger, M.D., Ph.D., Director, Medical Historian Training Program, Box 2914, Duke University Medical Center, Durham, North Carolina 27710.

Institute of Policy Sciences and Public Affairs

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of



a series of joint degree programs leading to the Master of Arts degree and a doctoral or professional degree. Such a program is designed to foster the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees. With the exception of those already possessing doctoral or professional degrees, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to other graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond that required by their doctoral or professional degrees.

The joint degree curriculum involves a minimum of ten courses to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy research sequence, in which the student works closely with faculty in a tutorial or a small group, stresses the development of analytical skills applicable to the broad range of policy areas.

Further information may be obtained from the Director of Graduate Studies, Institute of Policy Sciences and Public Affairs, 109 Old Chemistry, Duke University, Durham, North Carolina 27706.

Oak Ridge Institute of Nuclear Studies

Duke University is one of the sponsoring universities of the Oak Ridge Institute of Nuclear Studies located at Oak Ridge, Tennessee. The graduate research program at Duke has available to it all the facilities of the Oak Ridge National Laboratory and the cooperative supervision of student research by the staff at Oak Ridge. Fellowships in several fields of science are available to qualified applicants.

Graduate Fellowship Program. On application by a university, the Institute awards fellowships to candidates for the master's and doctor's degrees. The student uses the fellowship to conduct thesis research in an Oak Ridge laboratory.

AEC Special Fellowships. These fellowships are available in the fields of (1) nuclear science and engineering, (2) health physics, (3) advanced training in health physics, and (4) industrial hygiene.

The application deadlines depend upon the fellowship. Further information may be obtained from Lewis E. Anderson, Department of Botany, Duke University, Durham, North Carolina 27706.

Organization for Tropical Studies

Duke University is a member of a consortium created to promote an understanding of tropical environments and their intelligent use by man. To achieve these objectives, the Organization for Tropical Studies (OTS) fosters research and educational programs in the New World tropics.

Fellowships are available for travel and subsistence in field-oriented

programs in Central America. The basic course, Tropical Biology: An Ecological Approach, runs for an eight-week period in January-February and in July-August. Advanced offerings are periodically scheduled in agriculture, anthropology, botany, earth sciences, forestry, geography, marine biology, meteorology, and zoology.

The course schedules and application deadlines vary from year to year. Consult Dr. Donald Stone (Botany), Dr. Peter Klopfer (Zoology), or their respective departments.

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. degree requirements for that discipline and in addition he takes a program of electives which will aid his interdisciplinary competence in the medieval or Renaissance areas (or some intellectually valid combination of the two). Such a program includes a choice from the fields of art history, language and literature, history, philosophy, and religion. In other words, the student is enabled to minor in medieval and Renaissance studies.

The Committee on Medieval and Renaissance Studies awards three annual fellowships to outstanding doctoral students. Each fellowship is renewable twice, with renewal based on a review of the student's program by the committee.

The Committee on Medieval and Renaissance Studies sponsors also an undergraduate program, the *Journal of Medieval and Renaissance Studies*, a monograph series in the field, and lectures by distinguished visiting scholars.

Inquiries should be addressed to the Chairman, Duke University Committee on Medieval and Renaissance Studies, Box 4666, Duke Station, Durham, North Carolina 27706.

Social Systems Simulation Program

This is an interdisciplinary program to stimulate the use of model building and computer techniques in the social sciences. Although an outgrowth of the Econometrics Program, it is broadly based in that it involves the participation of faculty from business administration, economics, education, mathematics, political science, psychiatry, psychology, and sociology. It provides resources and facilities to predoctoral students pursuing the Ph.D. degree in a variety of fields. Inquiries should be addressed to the Director, Social Systems Simulation Program, P.O. Box 4774, Duke Station, Durham, North Carolina 27706.

Center for Southern Studies

The Center for Southern Studies engages in interdisciplinary inquiries into both the contemporary and historical South. It is concerned both with scholarly research and its practical application in the emerging industrial states of the region and has been instrumental in the creation of a multi-state Southern Growth Policies Board to foster regional economic planning. Under the auspices of the Board, southern business, labor, educational, and political leaders, including nine governors, are engaged in developing modern approaches to basic problems.

The center's Oral History Project focuses upon developing additional Black sources on the southern past in hopes of fostering a multi-racial history of the region. The center is also cooperating with the Department of History in training graduate students in the methods of oral research.

The center offers an interdisciplinary undergraduate course entitled *The Changing South* (IDC 199) which explores the geography, economics, politics, and culture of the region. The staffs of the center and the Perkins Library have created a Center for Southern Studies Reading Room containing over 300 volumes relating to the historical and contemporary South.

Inquiries relating to the Oral History Program should be addressed to Dr. Lawrence Goodwyn, 219 Old Chemistry Building, Duke University, Durham, North Carolina 27706.

Predoctoral Training Program in Sciences Related to the Nervous System

This training program is designed to develop scientists with a broad understanding of the current status, techniques, and approaches of the disciplines contributing to our knowledge of the nervous system, behavior, and mental health. Participants work toward the Ph.D. degree in one of the following participating departments: anatomy, microbiology and immunology, physiology and pharmacology, biochemistry and genetics, pathology, and psychology. In lieu of the minor field of study, they experience an expanded curriculum, tutorial courses, and seminar series in the current issues of neurobiology. Each curriculum is structured by a committee to satisfy the individual's needs and interests. This program is especially designed to foster the development of individuals who have a broad understanding of the neurosciences, and, in addition, are equipped to contribute to the expansion of knowledge through research in their fields. Further information may be obtained by writing Frans F. Jöbsis, Ph.D., Chairman, Training Committee, P.O. Box 3709, or Walter D. Obrist, Ph.D., Program Director, Duke University Medical Center, Durham, North Carolina 27710.

Stochastic Systems Program

A comparative program in stochastic systems analysis is sponsored by the Department of Electrical Engineering at Duke and the Department of Statistics of the University of North Carolina at Chapel Hill, in cooperation with the Departments of Mathematics at the two institutions. The program is designed for graduate students interested in applications of stochastic processes and statistical inference. A student interested in this area may enroll in any of the sponsoring or cooperating departments in a program leading to a master's or a doctor's degree, awarded through that department. Mutual interaction between the departments is provided by complementary course offerings and cooperative student advising. The student may thus arrange a variety of programs within the general stochastic systems area, emphasizing the more theoretical or the more applied aspects at his discretion. In addition to the courses regularly available, special courses will be offered on various topics. A stochastic systems seminar is an integral part of the program. Further information concerning this program may be obtained from either the Director of Graduate Studies, Department of Electrical Engineering, Duke University, Durham, North Carolina 27706 or Dr. C. R. Baker, Department of Statistics, University of North Carolina, Chapel Hill, North Carolina 27514.



Resources for Study



The Libraries

The William R. Perkins Library has shelf space for 1,500,000 books, seats for 1,250 readers, and a staff of 200. Since renovation of the old building completed in the spring of 1970, the complex provides room for 2,500,000 books and 2,100 readers. Study space includes nearly 700 carrels, 200 closed and 500 open, of which 475 are in the new building.

On the main floor—at ground level—are the reference and loan departments, bibliography, current periodicals, interlibrary loan, and all units of technical processing. Documents, newspapers, microtext collection, as well as a microphotography laboratory and other copying facilities are located on the floor below. The administrative offices and graduate reading room are on the second floor, with manuscripts and archives on the third. Twelve small reading and study rooms are provided in the stacks for the departments in the humanities and social science which grant the doctorate. Four seminar rooms are also located in the stacks.

Microphotography and photographic services utilize modern equipment for reproducing printed and manuscript materials and for the reading of materials in the microtext collection. A special room is available to film readers.

The combined University libraries, including Perkins Library and nine school and departmental libraries, contained 2,530,124 volumes in the summer of 1974. The Perkins Library had 1,491,739 volumes; the Undergraduate Library, 16,196 volumes; Divinity School, 172,358 volumes; Engineering, 52,440 volumes; Law, 186,493 volumes; Medical Center, 126,592 volumes; East Campus Library, 216,893 volumes; Biology-Forestry, 116,387 volumes; Chemistry, 31,509 volumes; and Mathematics-Physics, 47,800 volumes. Over 95,000 volumes were added in 1973-74. Approximately 12,500 periodicals and 208 newspapers are received currently.

The extensive resources of the Library for research students may be suggested by the following special collections:

The Trent Collection of Walt Whitman, containing the first, as well as all other important early editions or issues of *Leaves of Grass*; books and articles of Whitman biography and criticism; nearly 300 manuscripts, 400 letters, pictures, sheet music, and other miscellany.

The George Washington Flowers Collection of books, manuscripts, pamphlets, and newspapers on all phases of Southern history.

The Arents Collection of several hundred volumes relating to the culture and production of tobacco and the manufacture and distribution of tobacco products.

The James A. Thomas Collection of books on Chinese history and culture.

The Guido Mazzoni Library, a collection of approximately 23,000 volumes and 67,000 pamphlets covering Italian literature, with special strength in the nineteenth century.

The Gustave Lanson Library of 12,000 books and monographs on French literature.

Latin-American Collections, built around a Peruvian library of 7,000 books and manuscripts, a Brazilian library of several thousand volumes, and an Ecuadorian library of 2,000 volumes, supplemented by strong collections of the public documents of these and other Latin-American countries.

The Robertson Library of Philippiniana.

The Frank C. Brown Folklore Collection, consisting of about 38,000 manuscript pieces, 1,400 vocal recordings, and 650 musical scores of North Carolina folklore.

The Strisower Library of international law, numbering nearly 5,000 volumes, with rare books and periodical files.

The Trent Collection in the History of Medicine, (Medical Center Library), containing about 3,000 books and 2,500 manuscripts with special strength in anesthesia, anatomy, English medicine, vaccination, yellow fever, pharmacy, and medical biography.

The Holl Church History Library, dealing primarily with the period of the Reformation.

The Frank Baker Collection of Wesleyana and British Methodism, consisting of 1,500 editions of the works of John and Charles Wesley, 8,000 volumes concerning all phases of the development of British Methodism, 4,000 volumes relating to the religious and social background of British Methodism, and 4,000 manuscript pieces by the Wesleys and their coadjutors and by British Methodists of the last 200 years.

Collections in English and American literature, with emphasis on the eighteenth and nineteenth centuries, with the collections of Swinburne, Tennyson, Rossetti, and Bryant, significant groups of annotated copies and first editions of Coleridge and Byron, the Carroll Wilson collection of Emerson, some 5,000 items of eighteenth century English poetry and prose, and the Paul Hamilton Hayne Library of American literature.

In addition to these and other special collections, the libraries contain excellent files of United States federal and state documents, public documents of many European and Latin American countries, and publications of European academies and learned societies. The newspaper collection, with 15,000 volumes and 30,000 reels of microfilm, has several long eighteenth century files; strong holdings of nineteenth century New England papers and of antebellum and Civil War papers from North Carolina, South Carolina, and Virginia; as well as many European and Latin American papers. The manuscript collection of over 4,000,000 items is particularly strong in all phases of the history, politics, and social and economic life of the South Atlantic region, and includes significant papers in English and American literature. The collection of 130 Latin and 61 Greek manuscripts constitutes one of the outstanding collections of its kind in the United States.

Science Laboratories

Botanical and Zoological Laboratories. Facilities for graduate study in the Departments of Botany and Zoology are located on the West Campus. The Biological Sciences Building, completed in 1962, contains well-equipped modern laboratories for teaching and research in the fields of botany, forestry, and zoology. Special facilities include animal rooms, greenhouses, darkrooms, refrigerated and controlled-environment laboratories, scanning and transmission electron miscoscopes, a Van de Graaff accelerator, X-ray machines, radiation and radioisotope equipment, and other modern research facilities. Extensive facilities for experimentation in environmental control of plant growth are available in the phytotron adjacent to the botany greenhouses.

The herbarium contains over 360,000 specimens and includes notable collections of mosses and lichens. Other unique assets for teaching and research are the Sarah P. Duke Gardens on the West Campus; the four-acre experimental plot and field laboratory developed by the Department of Botany; the Duke Forest, comprising 8,000 acres of woodland adjacent to West Campus; the field station for the study of animal behavior; and the Duke University Marine Laboratory at Beaufort, North Carolina. Duke University, through the Botany and Zoology Departments, is a member institution of the Organization for Tropical Studies in Costa Rica, a facility which provides opportunities for course work and research in tropical flora and fauna.

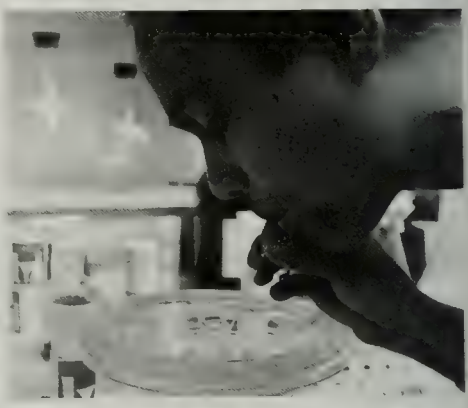
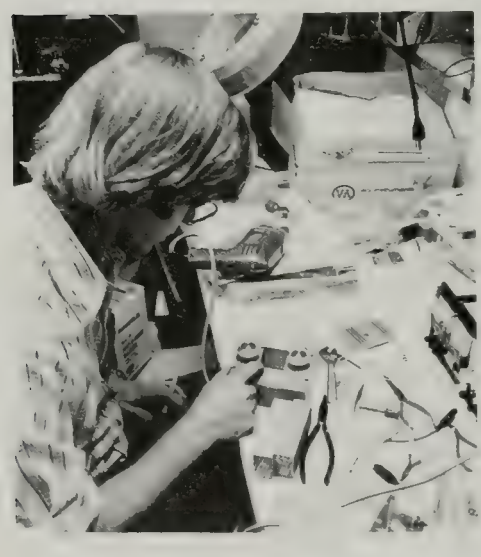
Scholarships for advanced study during the summer months are available through the Highlands Biological Laboratory, Highlands, N.C.; the Marine Biological Laboratory, Woods Hole, Massachusetts; and the Duke University Marine Laboratory. Requests for information concerning scholarships at the Highlands laboratory should be addressed to the Botany Department, concerning those at Woods Hole to the Zoology Department, and concerning those at Beaufort to the Duke University Marine Laboratory.

The Phytotron. The phytotron, officially known as the Duke University unit of the Southeastern Plant Environment Laboratories, is adjacent to the Biological Sciences Building and is administered by the Botany Department. The phytotron is an integrated series of plant-growth rooms, chambers, and greenhouses with over fifty separately controlled environments providing more than 4,000 square feet of plant-growing space. The controlled units consist of artificially lighted rooms with temperature and humidity controls, reach-in chambers, and six temperature-controlled greenhouses. By using the conditions in various day and night combinations, an exceptionally large number of environments can be obtained for testing the growth responses of plants. The phytotron also includes research laboratories and facilities for studying and monitoring the physiological processes of plants.

Research space in the phytotron is available to graduate students and faculty at Duke and to members of other educational and research organizations. For information concerning awards and research space, write to Dr. Henry Hellmers, Director, Department of Botany, Duke University, Durham, North Carolina 27706.

Marine Laboratory. The Duke University Marine Laboratory is located at Beaufort, North Carolina, one and one-half miles from open ocean. The physical plant includes six well-equipped research buildings, including the recently completed three-story research facility, six classrooms, and four dormitories, two of which are heated and air-conditioned for year round use. The laboratory provides excellent facilities for summer graduate courses in botany, chemistry,




geology, zoology, biochemistry, and physiology and for thesis research throughout the year. Special research and training facilities for field work in marine biology and biological oceaography inlcude two motor vessels and a 118-foot biological research vessel, *Eastward*, complete with apparatus for collecting and taking environmental measurements.

For information concerning research space, write to Dr. John D. Costlow, Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. For information concerning courses refer to Marine Sciences—the University Program in the section on Courses of Instruction.

Animal Behavior Station. The Animal Behavior Station, located less than one mile from campus, provides facilities for the study of penned, freeranging, and caged animals in a wooded area of eighty acres. These facilities include soundproofed observation chambers, barns, aviaries, and pens for large animals

and birds, and two waterfowl ponds. An extensive facility for the study of prosimian primates was completed in 1968. It contains one of the world's largest collections of lemurs in rooms especially designed for observational and behavioral studies. For information regarding research space or research assistantships in animal behavior, write to Dr. P. H. Klopfer, Department of Zoology, Duke University, Durham, North Carolina 27706.

Primate Facility. The Duke University Primate Facility is located in the Duke Forest adjacent to the Animal Behavior Station approximately two miles from the main campus. The colony is composed of approximately 200 prosimian primates representing 12 species. The animals are utilized by faculty members and students in the Departments of Anatomy, Anthropology, Psychology, and Zoology for research in cytogenetics, comparative anatomy, animal behavior, and physiology. Information concerning graduate study in one of the above mentioned areas should be directed to the director of graduate studies of the respective department. For information pertaining to the use of the Primate Facility and availability of research space write to Dr. J. A. Bergeron, Managing Director, Duke University Primate Facility, 3705 Erwin Road, Durham, North Carolina 27705.

Physics Laboratories. The Physics Building, containing about 130,000 square feet of floor space, is devoted to research and instruction in the Departments of Physics and Mathematics. An additional 27,000 square feet of space are provided in the Nuclear Physics Building completed in 1968 and located adjacent to the Physics Building. Graduate students are provided with office space in one of these two buildings.

In addition to the lecture halls and the elementary laboratories, there are instructional laboratories for work in electronics and advanced physics.

Nearly half the building is devoted to special laboratories for research in microwave spectroscopy and atomic, nuclear, high energy, low temperature, and solid state physics. Special equipment includes microwave spectrographs operating up to 500,000 megacycles; one 4 MEV and one high resolution 3 MEV Van de Graaff accelerator, a 30 MEV cyclotron/tandem Van de Graaff accelerator, a helium liquefier, cryostats, magnets, and associated equipment for research down to the millidegree Kelvin temperature range; a Sigma-5 and a DDP-24 computer used for automatic measurement and processing of bubble chamber film in the High Energy Physics Laboratory; and two DDP-224 computers used to collect and process data in the Nuclear Structure Laboratory.

The Physics-Mathematics Library contains a large selection of books and periodicals. A spacious, well-equipped instrument shop staffed by ten instrument makers, ten electronics technicians, and a glass blower is located in the building.

Chemistry Laboratories. In 1969 the Chemistry Department occupied a new building named after Dr. Paul M. Gross, a distinguished member of the faculty for many years. The building contains three and one-half floors which provide 146,440 square feet of total area. The usable space is over twice that of the original building and allows for considerable growth of departmental research programs as well as faculty and student body.

The Chemistry Building is well equipped and provides conditions conducive for research in many areas of current interest. Among instruments available are Varian T-60 and A-60 nuclear magnetic resonance spectrometers, a Varian C-1024 time averaging computer, a Consolidated Electrodynamics Corporation Type 21-490 mass spectrometer, a Bendix time-of-flight mass spectrometer Model 12, a Perkin-Elmer Model 621 infrared spectrophotometer

and Model MPF-3 fluorescence spectrophotometer, and other recording spectrophotometers for infrared and ultra-violet-visible studies. The department also has a PAR differential pulse polarograph, Digital Equipment Corporation PDL-8/L and PDP-8/F laboratory computers, a Beckman Model L3-40 preparative ultracentrifuge, an Anton Paar precision density meter, a Waters high pressure liquid chromatograph Model 202 and numerous other analytical and preparative gas chromatographs. Among other instruments of primary importance to specific research projects include Varian V-4502-15 and E-9 electron paramagnetic resonance spectrometers, Varian HR-60 and Bruker 100 Mc HFX-10 nuclear magnetic resonance spectrometers, a DSC-1B differential scanning colorimeter, a Baird-Atomic Fluorespec spectrofluorimeter, Cary Model 14R and Model 15 ultraviolet-visible spectrophotometers, a Durrum-Jasco ORD/UV/CD-5 recording spectropolarimeter and circular dichroism recorder, a Durrum-Gilison stopped flow spectrophotometer, polarographs, a flame photometer, and optical equipment for photochemical and kinetic studies. Equipment for X-ray crystallographic investigations includes a Rigaku-Denki low-angle X-ray diffractometer, a Kratky U-Bar camera, a General Electric XRD-5 diffractometer, a Picker automated full-circle X-ray diffractometer, an Enraf-Nonius automatic diffractometer, Debye-Sherrer powder cameras, and single Weissenberg and precession cameras.

The department has a machine shop, an electronics shop, and a glass-blowing shop. The facilities of the Duke University Marine Laboratory on the coast at Beaufort, North Carolina, are available for specimen collecting and processing in studies of organic chemicals of marine origin. In addition, two other major instruments located in the Research Triangle Park are available for use by the Chemistry Department. These are the A.E.I., Ltd., MS-902 high-resolution double-focusing mass spectrometer, and the IBM System 370 Model 165 computer, which is linked by cable to the Duke University Computation Center.

The Nanaline H. Duke Building. The Nanaline H. Duke Medical Sciences Building offers a superb environment for the creative research and graduate education of faculty and students in the Departments of Biochemistry and Genetics, and Physiology and Pharmacology. The building provides more than 65,000 square feet of laboratory space arranged in four towers around a central service core. Individual laboratories are designed to meet the special needs of research programs dealing with living organisms. Controlled environment rooms, darkrooms, materials-purchasing facility, electronics shops, a library, conference and reading rooms are provided. A vivarium for the temporary care and treatment of experimental animals is available.

Psychology Laboratories. The Psychology Department occupies approximately 53,000 square feet of air-conditioned space on the main campus. Housed there are general purpose laboratories, seminar rooms, classrooms, and a number of special facilities. For the study of animal behavior there are video-tape-recording facilities, a breeding colony of ring doves and pigeons, an extensive collection of prosimians, and operant conditioning laboratories. There are soundproofed and electrically shielded rooms for use with human and animal subjects; rooms for computer-controlled experiments in human perception and memory; photographic darkrooms; electrophysiological recording rooms; and a histological laboratory and surgery. The social psychology unit (used jointly with the Department of Sociology) contains observation, communication, and video-tape-recording facilities for the study of social interaction. There are interview and observation rooms for the study of human personality and clinical processes and a fully equipped experimental trailer

for studying the behavior of children on location. Both laboratory computers and remote access to the IBM 370 Model 165 located at the Triangle Universities Computation Center are available in the building. Machine, wood, and electronics shops are staffed by three full-time technicians. Other facilities for research and teaching are available in the laboratories and clinics of the adjacent Duke Medical Center.

A number of clinical installations for adults and children, specializing in clinical and guidance problems, cooperate with the department in providing facilities for research and training. In addition, the department operates an experimental school for first- and second-grade and preschool children and cooperates with the Department of Zoology in operating an eighty-acre field station and primate facility in nearby Duke Forest for the study of animal behavior in natural settings (see Animal Behavior Station).

Computation Center. The Duke University Computation Center, available to faculty and students for research and instruction, is presently equipped with an IBM System 370 Model 135 (320K bytes, one 3330 disk facility, three tape drives, two card readers, two printers, and a digital X-Y plotter) which is connected by high-speed telephone lines to an IBM System 370 Model 165 (three million bytes of memory, two 3330 and one 2314 disk facility, seven tapes, card reader, and printer) located at the Triangle Universities Computation Center (TUCC) which is in the Research Triangle Park. There are several low-speed keyboard terminals, in addition to three medium-speed terminals (card reader and printer) located in the Engineering Building, the Sociology-Psychology Building, and the Biological Sciences Building.

The Triangle Universities Computation Center is a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill.

Faculty members at Duke may use these facilities by filling out an application for computer services. All users of the Computation Center facilities are urged to obtain funds to pay for computer services; however, any user unable to obtain grant funding may ask for financial support from his department when he applies for the services.

More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

Engineering Research Laboratories. The laboratories of the four departments of the School of Engineering contain extensive basic equipment that may be applied in several specialized fields. Each laboratory also contains selected sophisticated equipment used in advanced research. The facilities available for instruction and research are suggested by a brief listing of items found in each department:

Biomedical Engineering. Holography and ultrasound apparatus; high energy CW helium-neon gas laser, and interferometrically stable table; cellular electrophysiology and neurophysiology instrumentation; stereomicroscope, micromanipulators, stimulators, isolation units, and microelectrode puller; facilities for studying biomedical materials and surface interactions; polarizing microscope, internal reflectance infrared spectrophotometer, and dialyzers; cardiorespiratory measurements; respirator, pressure transducers, and DEC PDP-12 digital computer.

Civil Engineering. Well-equipped research laboratories are available for work in environmental engineering, soil mechanics and geotechnical engineering, solid mechanics and materials engineering, structural mechanics and









structural engineering, fluid mechanics, water resources and ocean engineering, and urban systems and transportation engineering. Available research facilities include: two independent closed-loop electrohydraulic dynamic loading systems (MTS) capable of applying pulses of any shape and controlled in force or displacement modes, frequency range up to 100 cps., load capacity 6,000 and 100,000 lbs. (the 6,000 lbs. actuator can develop a constant crosshead speed up to 50,000 in./min.); equipment for manufacture and testing of fiber-reinforced polymer composites; environmental chamber for testing in the temperature range of -320° to 500° F., ultra-high-pressure triaxial shear apparatus for confining pressures up to 100,000 psi.; high-speed camera for studying explosions and similar phenomena; particle tracking X-ray equipment

for soil deformation studies; rock-testing facilities; model-testing equipment for anchored walls, penetrometer studies, and deep pile foundations; large-aperture research polariscope; and a reflective photoelastic polariscope; sustained-loading facility for long duration in studies of prestressed concrete; and a PDP-8 Digital computer with an 8K core memory size, teletype console, paper tape and magnetic tape I/0 capabilities, and teletype terminals which are also connected to the IBM 370/165 computer in the Triangle Universities Computation Center.

Electrical Engineering. High-resolution (7Å) electron microscope with heating and tilting stage; stereo-optical microscopes; ion-pumped bakeable ultra-high vacuum unit; helium dewars and cryostats; 4-inch and 9.5-inch electromagnets and 2-inch bore superconducting magnet; electron paramagnetic and nuclear magnetic resonance spectrometers; X-ray diffractometer with monochromator attachment; x-band microwave instrumentation; cryomagnetic facility for susceptibility measurements; analog and digital computer facilities including DEC Linc 8, PDP-8/I, and PDP-11/45 computers.

Mechanical Engineering. Digital data acquisition system with high speed scanner and magnetic tape; FM-AM instrumentation recorder; 4 square foot subsonic wind tunnel with six-component balance; hot-wire anemometer system; storage and dual-beam oscilloscopes; X-Y and strip chart recorders; temperature, pressure, strain, force, and acceleration transducers; electrodynamic shaker table; sound room; spectrum analyzers; analog computer facility; experimental pneumatic-tube transportation system (1800 ft. x 1 ft. diameter); fuel research engine; materials laboratories with stereo-zoom research metallograph, thermal analyzer, Instron testing machine, high-vacuum system, 10 kw RF generator, heat-treating and arc-melting furnaces, recorders, and darkroom.

The shop facilities of the school, as well as those located elsewhere on campus, are available to graduate students in all four departments.

The School of Engineering houses an IBM Model 2780 medium-speed cardreader punch and printer which communicates directly with the IBM System 370 Model 165 computer located in the Triangle University Computation Center in the adjacent Research Triangle Park.

Forestry Sciences Laboratory. The U. S. Forestry Sciences Laboratory of the Southeastern Forest Experiment Station is located in the Research Triangle Park near Durham. This research organization provides outstanding opportunities to complement research conducted by students in the Department of Forestry and Environmental Studies. Specialized research projects in forest entomology, pathology, physiology, and soils are currently underway at the laboratory. The staff of the laboratory is available for consultation and participation in seminars. Arrangements may be made for students to conduct certain aspects of their research at the laboratory.

Duke Forest. The Duke Forest serves as an outstanding field laboratory for the students and faculty of Duke University. This forest consists of nearly 8,000 acres on which grow various types of forests characteristic of the southeastern Piedmont region. Shortleaf pine, loblolly pine, and southern hardwoods represent the main timber types.

Much of the Duke Forest is adjacent to the campus and easily accessible. This provides students and faculty with excellent opportunities to conduct studies in various fields of forestry such as ecology, entomology, land management, meteorology, pathology, physiology, and soils.



Student Life



Living Accommodations

Duke University offers varied living accommodations to married and single graduate students. A brief description of each follows:

Residence Hall Accommodations. The Graduate Center, located near the Duke Medical Center, houses 149 male graduate and professional school students, 56 women graduate and professional school students, and 119 undergraduate women. Room assignments are made in order of application: students first applying are those first assigned.

The graduate women's section, in the center and south wings of the second floor, and the undergraduate women's section on the third floor, are separated from the men's residential area. Resident counselors advise all occupants, and often work in conjunction with a representative house committee.

Single rooms in the men's section are reserved for returning students; other rooms are for double occupancy. Each room is equipped with the following furnishings for each student: bed with innerspring mattress, chest with mirror, desk with chair, and book shelves.

Town House Apartments. These apartments are intended primarily for single graduate and professional school students, though married students and families may be housed in individual apartments. All apartments have two bedrooms, air-conditioning, and furnishings for three students.

Central Campus Apartments. This complex of 500 units will be operated for the entire student community of the University and the Medical Center. An allocation plan will be followed so that each segment of the student community is represented in the apartments. Because of this and an expected turnover of about 25 percent annually, not all student applicants may be accommodated at the time they desire.

The first 92 units were open for occupancy in August, 1974. The University will open completed buildings throughout the 1974-1975 academic year and will make these units available for students in accordance with the allocation plan through the fall and spring semesters and summer months.

One-bedroom, two-bedroom, and three-bedroom apartments will be open to single students. Apartments for married students will include a few furnished efficiencies, and some one-, two-, and three-bedroom units in which the kitchen, living room, and first bedroom will be furnished. The monthly rental rates for these apartments will be lower than those for apartments offered on the Durham housing market.

Application Procedure. The Department of Housing Management provides students accepted to the University with housing application forms and detailed information on rates, rental agreements, and availability of housing. A completed and returned application form, accompanied with the required $50 residential deposit, will reserve a housing unit.

Off-Campus Housing. The Department of Housing Management maintains lists of rental apartments, rooms, and houses provided by Durham property owners or real estate agents who have agreed to rent to students and not to discriminate in renting by race, creed, or nationality. These lists are available only in the Department of Housing Management office. The Manager of Apartments and Property and his staff will assist any member of the Duke community in seeking suitable off-campus housing; however, off-campus rental properties are not inspected or approved, nor does the University or its agents negotiate with owners for students, faculty, or staff.

For information on the cost of housing, see the section on Financial Information.

For additional information, write to: Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, North Carolina 27706.

Food Services. Food service on the East Campus is cafeteria style. The dining facilities on the West Campus include one cafeteria with multiple-choice menus, one area which includes cafeteria counters as well as a grill, and a table-service dining room, the Oak Room, where full meals and *a la carte* items are served. The Cambridge Inn, a self-service snack bar also located in the West Campus Union, is open from 9:00 a.m. until 12:30 a.m. each day except Saturday. All types of snack and sandwich items are available there. The Graduate Center has a public cafeteria and a coffee lounge open until 1:00 p.m. Because of the large numbers served in the dining halls, it is not possible to arrange special diets for individual students.

The cost of meals approximates $3 to $4 per day, depending upon the needs and tastes of the individual.

Services Available

Medical Care. The aim of the University Health Service is to provide any medical care and health advice necessary to the student as a member of the University community. The Health Service maintains the University Health Services Clinic located in the Pickens building on West Campus and the University Infirmary on the East Campus. Emergency transportation can be obtained from the Duke Campus Police.

The Student Health Program offers varied benefits. To secure these benefits a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until he has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, or (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

Under this program the University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the Clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment. Fees for such consultations or treatments must be paid by the student if he is not covered by an insurance plan.

Under this program the facilities of the University Infirmary are available

during the regular session from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined to the Infirmary.

The student Mental Health Service, located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment of matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments per year with the Student Mental Health Service at no charge. Further interviews can be arranged, either with this staff or with a variety of other professionals, at a fee commensurate with the student's ability to pay.

All Duke University Medical Center resources are available to all Duke students and their spouses and children, although any bills incurred at Duke Hospital or any other hospital are the responsibility of the student, if he is not covered by an insurance plan. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the University's Student Accident and Sickness Insurance Plan for an additional fee.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse or spouse and child. Although participation in this program is voluntary, the University expects all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke Plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the



policy is from opening day in the fall. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

The Duke University Counseling Center. Through the Counseling Center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. The staff conducts continuing research in counseling and testing.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business and industry, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with graduate students about their future professional plans. Graduate students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions, and to have a permanent file for future reference. Pertinent recommendations should be accumulated while a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year for students registered with the Office of Placement Services.

Student Affairs

Cocurricular and Recreational Activities. Graduate students at Duke University are welcome to use such recreation facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities. Graduate women and wives of graduate students may join the Graduate Women's Club.

A full program of cocurricular and recreational activities is presented by the Associated Students of Duke University, Cultural Affairs Office, Duke University Christian Council, Duke University Union, Student Activities Office, Y.M.C.A., Y.W.C.A., and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office; Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office, 204 Flowers Building.

The Information Center, Page Box Office, publications offices, art gallery, meeting rooms, lounges, and recreational facilities are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the Duke University *Annual Calendar;* detailed and updated information in the *Weekly Calendar,* available on each Friday; and the Duke *Chronicle,* available each Monday through Friday. Copies may be obtained at the Information Desk or the Calendar Office, Page Building.

Graduate Student Association. The Graduate Student Association provides a formal means of communication between the graduate student body and

the faculty and administration. Membership in the association is open to all registered graduate students. This student-organized association meets monthly, with representatives present from the graduate enrollment of each department. It is governed by a steering committee elected annually from the membership and among other functions provides graduate student representation on campus committees including those concerning the library, housing, and governance.

Research and Publications

The departments of Duke University are devoted to research as well as to instruction. Since a prime purpose of the University is the promotion and diffusion of knowledge, attention in the Graduate School is focused on research and publication.

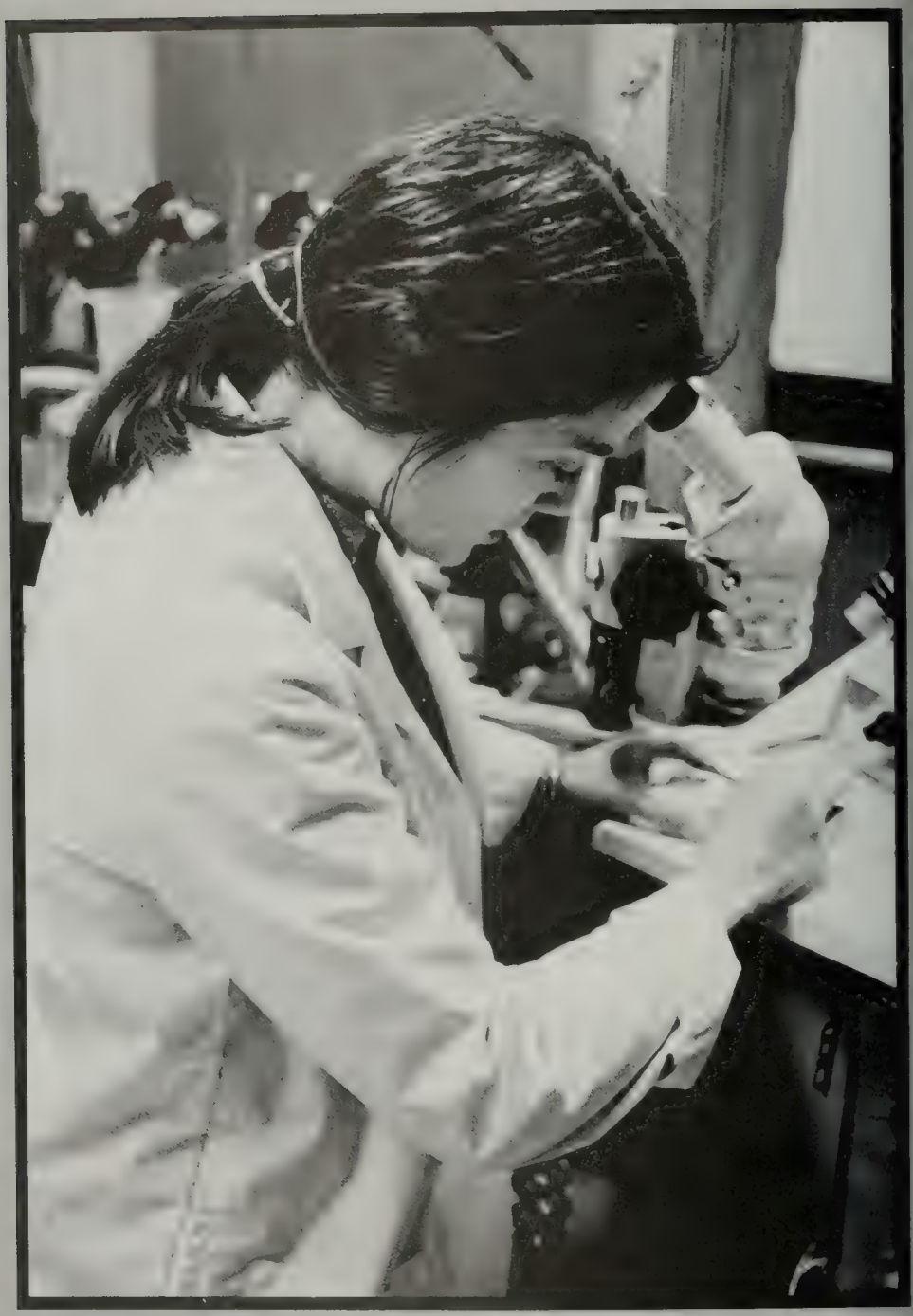
To this purpose, the Provost annually appoints a University Research Council which receives applications from members of the various faculties for subsidies in support of research. Forward-looking policies of this Council have encouraged the initiation and completion of substantial research projects.

The Duke University Press was created in 1925 as a successor to the Trinity College Press. It continued the publication of the *South Atlantic Quarterly*, published at Trinity College since 1902, and in 1926 it revived the *Hispanic-American Historical Review*, which had been founded and published from 1918 to 1922 by a group of scholars interested in Hispanic America. In 1929 *American Literature* was begun with the cooperation of the American Literature Group of the Modern Language Association. This journal was followed in 1931 by *Ecological Monographs*, and in 1932 by *Character and Personality* (since 1945 entitled the *Journal of Personality*). In 1935 the press began the publication of the *Duke Mathematical Journal*. Since 1948 it has published *Ecology*, the official journal of the Ecological Society of America. In 1965 it began publication of *American Literary Scholarship* (an annual), in 1969 the *History of Political Economy*, and in 1971 the *Journal of Medieval and Renaissance Studies*. In 1970 the press assumed publication of the *Bulletin of the Ecological Society of America*.

Since its organization the press has published over five hundred volumes. Included are five series: the Duke Historical Publications, the Duke Studies in Religion, the publications of the Lilly Endowment Research Program in Christianity and Politics, those of the Program in Comparative Studies on Southern Asia, and, largest of all with forty-one volumes to date, the publications of the Duke University Center for Commonwealth Studies. In the broadest sense, the policy of the press is to make available to the public any scholarly work that merits publication, though special attention is given to works in fields of knowledge cultivated by the University.

Visiting Scholars

The libraries and other facilities of Duke University are made available, to the extent practicable, to faculty members of other colleges and universities who wish to pursue their scholarly interests on the Duke campus. Identification cards are furnished visiting scholars by the Graduate School Office. Such visitors are not charged unless they wish to participate in activities for which a special fee is assessed. Assistance in finding housing is available from the Department of Housing Management. Inquiries pertaining to visiting scholars should be addressed to the department chairman concerned or the Dean of the Graduate School.



Admission



Students Requiring Admission

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as Special Students in the summer session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program. All applicants are considered without regard to race, color, religion, sex, or national origin.

Prerequisites

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Usually the student should have majored in the area of intended graduate study. Many departments (see the chapter on Courses of Instruction) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see Language Requirements).

Procedures

A student seeking admission to the Graduate School should obtain an application blank from the Dean of the Graduate School. This should be filled out completely and returned promptly. Each application must be accompanied by a non-refundable fee of $15 in check or money order payable to Duke University. In addition the student should provide the following supporting documents: (1) two copies of the official transcript from each college, university, or seminary attended sent directly to the Dean by the institution; (2) two supplementary transcripts, sent as soon as possible, showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to judge the applicant as a prospective graduate student, and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Tests for all de-

partments; and (5) scores on the Graduate Record Examination Advanced Test for biochemistry, botany, chemistry, English, mathematics, microbiology, pathology, physics, physiology, psychology, Romance languages, sociology, and zoology.

Applicants to the Graduate School of Business Administration and the Department of Health Administration are required to take the Admission Test for Graduate Study in Business, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate Record Examination no later than the October testing in order to meet the February 1 deadline. Information on times and places of the Graduate Record Examinations can be provided by the applicant's college or the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Additional Procedures for Foreign Students. Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with the application material (1) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through The Educational Testing Service in Princeton, New Jersey, or, if the student is in the United States, a statement of his English proficiency written by a professor of English at the student's university; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per calendar year are $6,200); and (3) a statement by a qualified physician describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program by 3 units. Tuition charge for this course will be $48.00 per unit. A student who does not successfully complete this course during the first year of residency will not be permitted to continue his graduate work at Duke University. Passing this examination or the course, if it is required, will not meet degree requirements for a foreign language. (See Language Requirements for Foreign Students.)

Notification of Status. When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is *not complete* until the acceptance form has been returned. An admission offer is for the semester specified in the letter of admission.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. *Provisional admission* for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. *Nondegree admission* is offered to students who meet the admission requirements and who desire to engage in graduate study not subject to the restrictions of a graduate degree program. With the approval of the student's major



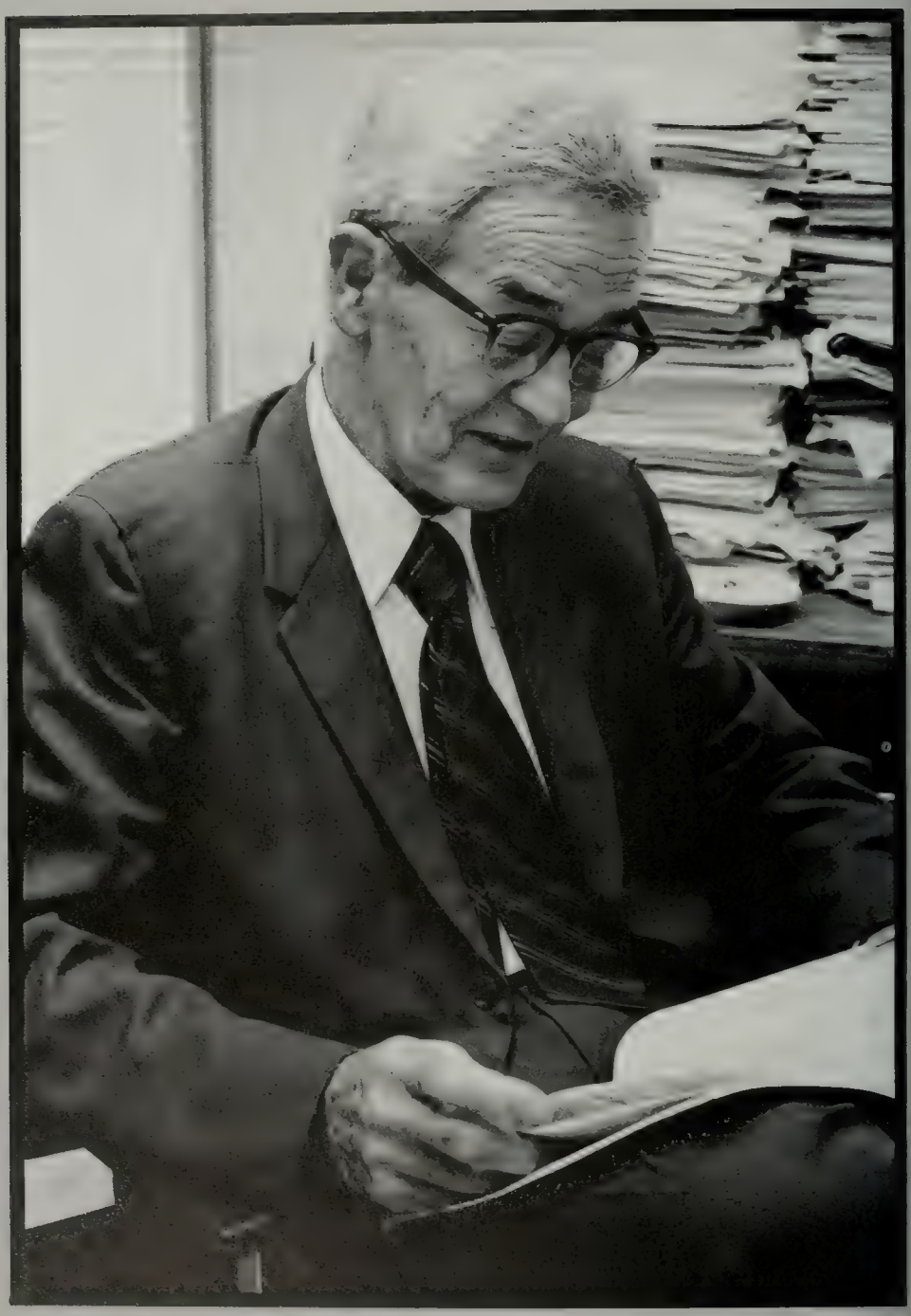
department and the Dean of the Graduate School, a maximum credit of 6 units earned under nondegree status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. (See ruling on page 4.)

Deadlines for Application. It is the applicant's responsibility to make certain that the Graduate School Office has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted at least *two weeks* before the closing dates listed below:

Fall semester, admission and award	February 1
Fall semester, admission only	July 15
Spring semester, admission only	December 1
Summer session, 1976* first term	April 15
Summer session, 1976* second term	May 15
Summer session, 1976* third term	June 15

Anyone whose folder is not complete before that date will face the possibility that departmental enrollment will have been filled. While the Graduate School Office will process all applications, it can not guarantee full consideration of a folder for each department after April 15.

*Students seeking admission to the Graduate School for study in the summer session should make application to the Dean of the Graduate School as well as to the Director of the Summer Session.



Financial Information



Tuition and Fees*

Tuition for all students for a full semester program amounts to $1,440 (15 units at $96 per unit). Part-time tuition is calculated at the same rate of $96 per unit. Tuition charges are due and payable, unless otherwise specified, at the time of registration for that semester and are subject to change without notice. Registration is not considered complete and students may not be admitted to classes until arrangements have been made with the Bursar of the University for settlement of tuition and fees. A late registration fee of $25 is charged any student not completing registration during the registration periods. The *in absentia* fee is due on the date of registration and is subject to the late registration fee if not paid by that date. The fee is $96 for 1 unit per semester.

Students passing the preliminary examination may obtain a reduction in their registration and tuition fee at any time during the five-week period beginning on registration day. No other refund in fee may be obtained. A reduction in registration may be made due to changes in departmental service requirements of assistants provided it is made during the first fourteen days after registration and is approved by the Dean. Any fee reduction for this reason is credited to future registration fees. In the event of death or involuntary call to active duty, refunds will be made on a pro rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition, and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before classes begin: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, or fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

*The figures contained in this section are projected and are subject to change prior to the beginning of the fall, 1975, semester.

Fees incurred in connection with thesis or dissertation submission are as follows:

*Binding fee, three copies of thesis or dissertation, other copies optional $5.00 per copy $15.00
Microfilming fee, doctoral degree only, upon final submission ... $25.00
Copyright fee (optional) $15.00

An athletic fee of $25 for the year is optional and payable in the fall semester. The Treasurer of the University has sole responsibility for collection of fees and for arranging for the proration of fees.

Special Tuition Rates for Teachers and Others. The Graduate School recognizes a special obligation to encourage the following types of students in their professional and personal advancement: (1) members of the faculties and administrations of the neighboring public schools and colleges, currently engaged in *full-time* school work while taking courses in the Graduate School, (2) ministers of neighboring churches, (3) spouses of Duke faculty members, (4) *full-time* employees of Duke University who are paid on a bi-weekly or monthly basis *throughout* the year and have been employed for one year. The reduced tuition rates specified below do not apply to teachers and ministers while on leave of absence, or to holders of fellowships, scholarships, or graduate and research assistantships, or to part-time instructors. Persons working toward a degree cannot hold a faculty rank above that of instructor.

Persons eligible for the reduced tuition rate must meet the admission standards required of all graduate students and must be admitted to the Graduate School. They may enroll for one or two courses per semester (in no case totaling more than 7 units) upon payment of a fee of $5 for registration for each semester and tuition of $48 per unit of credit or an audit fee of $40 per course. Residence requirements cannot be fulfilled at the reduced rate. Students enrolled in doctoral programs are not eligible for the reduced rate.

Fees for Undergraduate Courses. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course.

Audit Fee. Any registered student may audit without charge up to three courses per semester if he is registered for at least 15 units, or up to two courses per semester if he is registered for at least 9 units. Otherwise an audit fee of $40 per course is charged.

Vehicle Fee. Each student possessing or maintaining a motor vehicle at Duke University shall register it at the beginning of the academic year in the Security Office at 2010 Campus Drive. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, he must register it within five (5) calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of $20 for each motor vehicle or $10 for each two-wheeled motor vehicle. Resident students first registering after January 1 are required to pay $14 for a motor vehicle or $7 for a two-wheeled motor vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate, valid driver's license, and satisfactory evidence of automobile liability insurance coverage with limits of at least $10,000 per person and $20,000 per accident for personal injuries, and

*If more than one snap binder is required per copy of the dissertation, a deposit of $3.50 will be collected for each additional snap binder.

$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

If a motor vehicle or a two-wheeled motor vehicle is removed from the campus permanently and the decal is returned to the Traffic Office prior to January 1, there will be a refund of $10 for a motor vehicle and $5 for a two-wheeled motor vehicle.

Transcript Fee. A student who wishes to obtain copies of his academic record should direct requests to the Registrar's Office. A minimum fee of $2, payable in advance, is charged for a single copy. Where two or more copies are forwarded to a single address, a charge of fifty cents will be made for the second and succeeding copies.

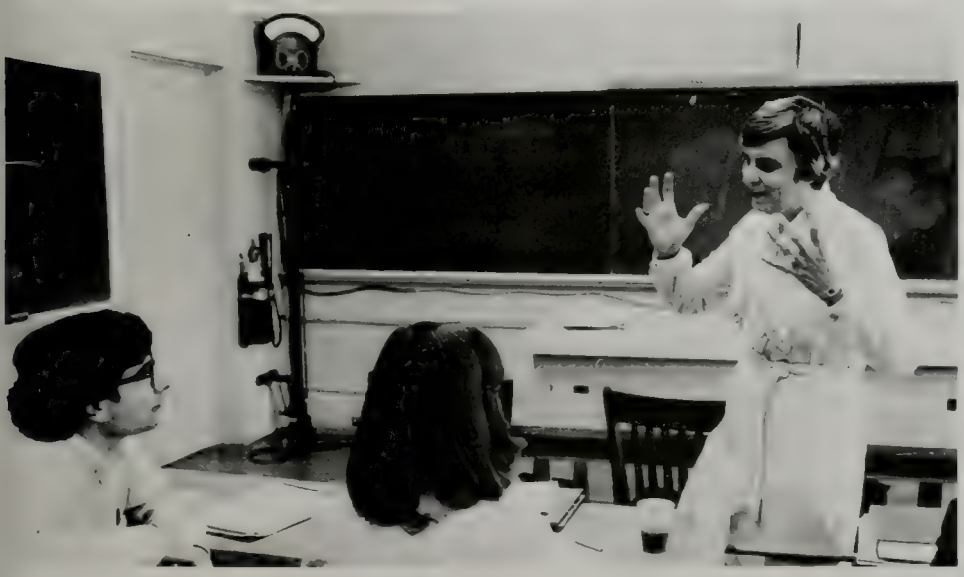
Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Expenses*

Housing Fee. The charge for each person in a double room for the academic year is $416 in the Graduate Center. The fee for Town House Apartments, not including utilities, is $653 each for the academic year on the basis of three students to an apartment. Fees for single students and rental rates for married students in Central Campus Apartments will be quoted by the Manager of Apartments and Property.

Housing fees are subject to change prior to the 1975-1976 academic year. A $50 deposit is required on all reservations. No refund on housing fees is made to students who withdraw after the date of registration, except for those who involuntarily withdraw because of a call to active duty in the armed forces. Such refund will be made in accordance with the University's established schedules. For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

*The figures contained in this section are subject to change prior to the beginning of the fall, 1975, semester.



Food. Food service, on both the East Campus and the West Campus, is described under Living Accommodations in the chapter on Student Life. The cost of meals approximates $700 to $850 per year, depending upon the needs and tastes of the individual.

Summary. The following table represents an estimate of a graduate student's basic expenses for one academic year for a full program of work. These figures do not include allowances for recreation, travel, clothing, and other miscellaneous items which vary according to personal needs and tastes.

Tuition	$2,880.00
Room Rent (Graduate Center)	416.00
Board	850.00
Laundry	85.00
Books	200.00

Fellowships and Scholarships

James B. Duke Fellowships. The James B. Duke One Hundredth Anniversary Fund provides fellowships for students who wish to pursue a program leading to the Ph.D. degree in the Graduate School at Duke University. Its objective is to aid in attracting and developing outstanding scholars at Duke. Selection is made by a faculty committee upon nomination by the student's department. These fellowships provide for payment of tuition for full registration plus an income stipend of $300 per month for the first two calendar years and $310 per month for the academic year during the third and final year. The award requires no service and is renewable each year upon satisfactory progress. The total value of a James B. Duke Fellowship over the full three years of tenure is approximately $16,600. There are 39 James B. Duke Fellows currently enrolled.

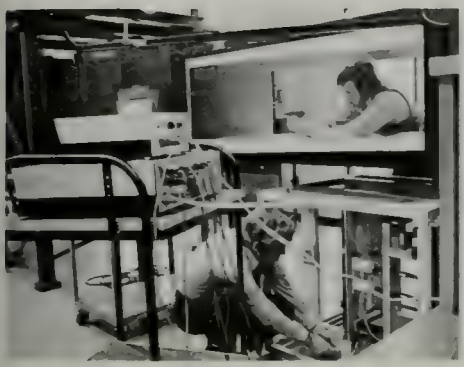
Endowed Fellowships. Other special endowments provide fellowships for graduate study. The Angier B. Duke Fellowship provides support of $4,500 for one student for the academic year. There are six Gurney Harris Kearns Fellowships in Religion ranging in value up to $3,800. Selection for these fellowships is made through faculty committees.

Graduate Fellowships. Graduate Fellowships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Stipends range from $2,400 for the academic year to $5,500 for a full calendar year. In 1974-1975, there were 80 students holding these fellowships.

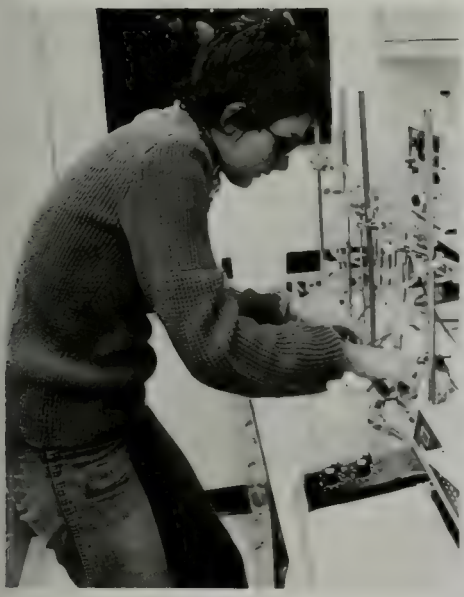
Federal Fellowships.* Duke University participates in the following program:

National Defense Education Act, Title VI Fellowships. The purpose of this program is to encourage persons to undertake advanced training in modern foreign languages and in related area studies not commonly taught in the United States. The world area in which National Defense Foreign Language (NDFL) Fellowships are offered at Duke University is Southern Asia. Fellows must engage in intensive study in a language of the world area during their tenure, as well as pursue work toward their degree. The fellowships carry academic-year stipends of $2,000, $2,200, or $2,400, depending on the stage of

*United States citizenship is generally a requirement for eligibility.









graduate study, plus tuition and allowances of $500 for each eligible dependent (with a maximum number of four). In 1974-1975, six students at Duke University held NDFL Fellowships. Interested persons should contact the International Studies Center.

Other federal programs support fellowship, traineeships, and research assistantships through departmental auspices. Approximately 475 students were supported through these programs during 1974-1975.

Canadian Studies Fellowships. These fellowships are financed by the Donner Foundation for American citizens or permanent residents in the United States who take graduate courses or do research in Canada. The awards are for one year, and the stipends vary from year to year. The award for a nine-month academic year is usually $300 per month plus tuition at the rate for students who have passed the preliminary examination. Teaching Assistantships are financed by the Office of Education, Department of Health, Education and Welfare. They may be held by American residents or, in certain circumstances, by Canadian citizens.The remuneration is $475 per month for nine months, less tuition fees. Further information can be obtained from the Director of Canadian Studies, Center for International Studies, 2101 Campus Drive, Durham, North Carolina 27706.

Fellowships in Medieval and Renaissance Studies. Three fellowships are awarded annually by the Duke University Committee on Medieval and Renaissance Studies. Fellows are chosen from among students engaged in Ph.D. programs, and they receive full tuition plus a monthly stipend of $244 for nine months. They may request two renewals of their appointment.

Special Fellowships. The following special fellowships are available to qualified Duke students from sources outside the University:

Shell Fellowships in African Studies. These are available to qualified students in social sciences who are preparing for careers in the State Department, including the foreign services of the United States, the United Nations, or other international agencies, or in research and teaching in international affairs in academic institutions within the United States. They must be citizens of the United States or, at present, residing permanently in the United States and intending to become citizens. The fellowships are intended to cover the expenses of field research in the preparation of doctoral dissertations. The stipend for each fellowship is $4,000 plus a reasonable amount for transportation expenses. Inquiries should be made to the Administrative Assistant, Center for International Studies, Duke University.

Cokesbury Graduate Awards in College Teaching. These awards are sponsored by the Board of Education of the Methodist Church. They are designed to assist graduate students who are committed to a Christian philosophy of higher education and who intend to teach in college. The applicant must have been a member of the Methodist Church for at least three years, and must have been accepted for or currently be pursuing a program of graduate studies at one of the Methodist-related universities, including Duke University, approved for this program. Awards for one year vary in amount from $500 to $2,500. Applications must be completed before February 1. Further information and application forms may be obtained from the Dean of the Graduate School.

Exchange Fellowships with the Free University of Berlin. These fellowships are available through an exchange arrangement with the Free University of Berlin which will provide fellowships for two graduate students to study during the regular academic year in Berlin. Departments will submit nominations to the Dean of the Graduate School before February 1.

Departmental Fellowships. Various departments and schools in Duke University have fellowships which are available to students pursuing appropriate studies. Departments should be consulted for further information.

Graduate Scholarships. Graduate Scholarships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Awards are for full or partial payment of tuition and range in value to $2,580. In 1974-75, 68 students held Graduate Scholarships.

Summer Scholarships. A small number of Summer Scholarships which provide a payment of $400 are available to students engaged in full-time study during the summer session. Interested students should consult their director of graduate studies.

Assistantships

Graduate Assistantships. Appointments as graduate assistants carry a total stipend up to $4,800 for the academic year. The value of the stipend is deter-

mined by the time given to assisting, the qualifications of the assistant, and the nature of work assigned. In 1974-1975, 176 students held Graduate Assistantships.

Research Assistantships. Appointments are for predoctoral candidates whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments. Stipends may be up to $4,800 depending on the nature of the assistance and the assisting time required. In 1974-1975, 179 students held Research Assistantships.

Part-time Instruction. Several departments offering graduate work make use of exceptionally qualified graduate students as part-time instructors, tutors, and teaching assistants. These students are usually able to register for a graduate program of 9 units a semester.

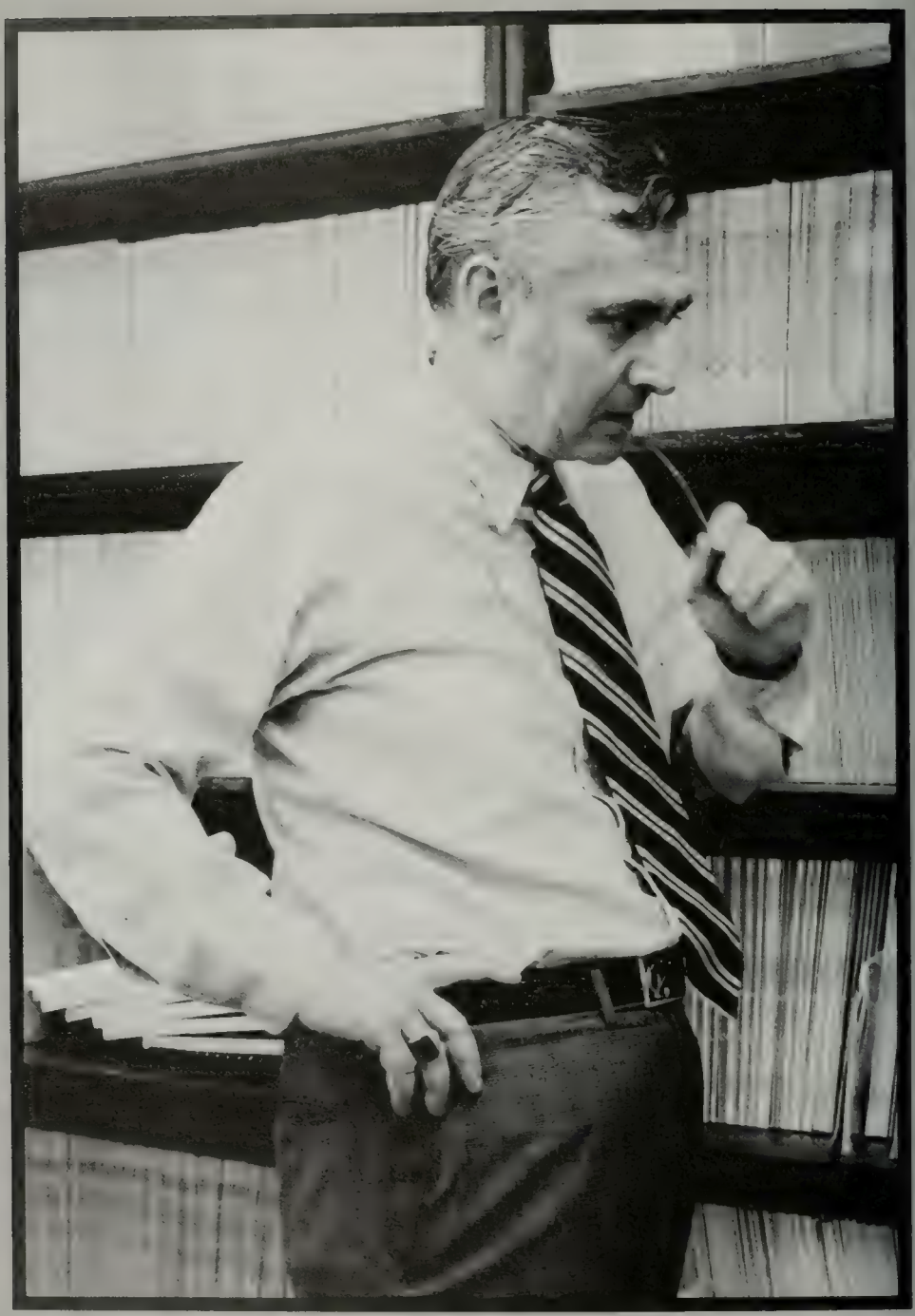
Payment of Awards

The payment of stipends to graduate students holding awards starts on September 30 and is made in nine equal monthly payments on the last working day of each month thereafter. The Controller of the University has sole responsibility for paying all stipends to students.

Ordinarily stipends awarded under fellowships and scholarships are not subject to income and Social Security tax. However, a portion of the award to graduate assistants and research assistants may be subject to both. The Graduate School Office will supply detailed information.

Loans

It is the policy of Duke University to provide loans when needed to help students meet their educational expenses. Only students with full-time status who can demonstrate need according to established guidelines are eligible for loans. Loan funds are provided through the Federally Guaranteed Student Loan Program and the National Direct Student Loan Program. There are also loan funds solely under institutional control. Generally, loans made from these funds bear no interest charge to qualified borrowers while they maintain student status and for a short period thereafter. Interest during the repayment period is at a generally favorable rate. Any student wishing to apply for a loan must, as a first step, complete a Graduate and Professional School Financial Aid Statement (GAPSFAS) form. If this form has been completed in connection with a loan application to another institution, the student may request that a copy of the analysis be sent to the Graduate School instead of again completing the form. An analysis of financial need will be made on the basis of the information from the GAPSFAS form. Additional information may be required of students who do not qualify as financially independent of their parents. GAPSFAS and other forms which accompany loan applications may be obtained on request from the Graduate School Office. Loan applications should be made prior to July 1 for the subsequent academic year.



Registration and Regulations



Registration

Who Must Register. All students must register (1) who enter course work or residence for credit; (2) who have completed minimum requirements for an advanced degree, but continue to use the facilities of the University in their research; (3) who have *in absentia* status; or (4) who wish merely to audit a course or courses.

Registration Periods. After receiving notification of admission to the Graduate School and returning a statement of acceptance of admission, the student must register for the term indicated in the admission letter. He first confers with the director of graduate studies of his major department who prepares and signs a course card listing the course work to be taken during the semester. The student then presents this course card to registration officials for enrollment in the selected courses. After a student's first registration he must register for subsequent semesters at the regular, stated time for registration. Currently enrolled students who fail to register at the first scheduled registration period for the subsequent semester incur a penalty for late registration. *Former students* who intend to register to resume a degree program must give the department and the Dean notice of this intention two months before registration.

Late Registration. All students are expected to register at the times stated in this *Bulletin*. A late registration fee of $25 is charged any student registering late, including a current student who, (1) delays registering until the special registration for new students or, (2) must register *in absentia*.

Change of Registration. Within a period of *two weeks* from the day of registration, registration may be changed with the approval of the director of graduate studies if no reduction in fee is entailed. If fees are to be refunded, the approval of the Dean of the Graduate School is required. For the succeeding two weeks, courses may be dropped and equivalent hours of research or residence credit added with the approval of the director of graduate studies, the instructor of the course, and the Dean. Students who pass the preliminary examination during the first five weeks of a semester may alter their registration with fee adjustments any time during the first five weeks of that semester.

Academic Regulations

Residence.* Although graduate study consists principally of individual reading, research, and laboratory experimentation under guidance, academic progress in the United States is generally measured and recorded in terms of course hours and credits. Credit for courses and seminars, research, and residence, and corresponding tuition and fees are stated in terms of units. One unit is equivalent to one semester hour. The term *residence* designates full-time study and research in close proximity to the facilities provided, as opposed to part-time study incidental to a full-time occupation. For purposes of satisfying the residence requirement of the various degrees, residence of one year is defined as two successive academic semesters of no less than 9 units registration each semester. (See the chapter on Graduate Study in the Summer Session for residence required of master's candidates engaged solely in summer study.) Each student must register for a full program until he passes the preliminary examination.

Faculty Ruling. No member of the instructional staff who is a candidate for a degree in the Graduate School of Duke University can hold a faculty rank above that of instructor.

Course Load. A graduate student is considered fully registered when he enrolls for the number of credits his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in fulfilling his degree requirements. In the academic year normal registration for the *resident doctoral* student who does not hold an appointment as part-time instructor or assistant or does not engage in part-time work is 15 units a semester or 30 units an academic year. The registration for the *resident doctoral* student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties. The resident doctoral student carries full registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units each semester until the dissertation is accepted. If he elects to go out of residence (away from the University), he registers for 1 unit each semester *in absentia* in order to keep his program active.

The registration requirements for a resident student pursuing a master's degree are the same as the requirements for students pursuing the doctorate. Once the student has completed all requirements except the thesis, he may reduce his registration to the 3 units per semester, *provided he has not matriculated in a doctoral program at Duke.* If he decides to go out of residence (away from the University), he registers for 1 unit *in absentia*. Regulations pertaining to a resident student engaged in a master's program requiring no thesis are identical to those described above for the doctoral student up to and including the semester in which his course requirements are satisfied. At that point, he may reduce his registration to the number of hours necessary for completion of his degree program.

In each term of the summer session 6 units is maximum registration. Students who are in residence during the academic year and wish to continue study and to use University facilities including the Student Health service during the summer must register for 1 unit in the first summer session term. This registration provides use of facilities for three terms of the summer session.

*See also section on Program Information.

The registration of 1 unit a semester *in absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health.

It is necessary to be a fully registered student according to the regulations listed above in order to establish eligibility for library carrel and laboratory space, student housing, University and some outside loans, and the Student Health Service (including accident and sickness insurance; see section on Student Life).

Credits. The following regulations pertain to credits earned outside of the Duke University Graduate School:

Graduate Credit Earned before the A.B. Degree is Granted. Ordinarily no credit will be allowed for graduate courses taken before a student has been awarded his A.B. or B.S. degree. However, an undergraduate student at Duke University, who at the beginning of his final semester lacks no more than 9 semester hours of fulfilling the requirements for the A.B. or B.S. degree, may obtain permission from the Dean of the Graduate School to enroll for graduate courses to bring his total program to 15 hours a week. Such graduate courses may be credited toward the A.M., M.S., M.B.A., M.Ed., or M.A.T. degree, provided that the student meets the requirements for admission to the Graduate School, and that he is duly registered in the Graduate School at the beginning of the semester in which he intends to earn graduate credit.

Transfer of Graduate Credits. Transfer of credit for graduate course work completed at another institution will be considered only after a student has earned a minimum of 12 units of graduate study at Duke University. After completing the 12 units, the student should file a request for transfer of credits on the appropriate graduate school form.

Graduate Credit for Courses Taken in the School of Law. Upon recommendation of the director of graduate studies, and approval of the Dean of the Graduate School, students in the social sciences may take certain courses in the School of Law for graduate credit. In some instances courses in the School of Law may be considered as fulfilling a student's requirements for related work. To register for such courses, the student should present a letter from his director of graduate studies to the Dean of the School of Law requesting permission to register for specific courses.

Reciprocal Agreements with Neighboring Universities. Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh, students properly enrolled in the Graduate School of Duke University during the regular academic year, and paying full fees to this institution, may be admitted to a maximum of two courses per semester at one of the institutions in the cooperative plan. Under the same arrangement, students in the graduate schools in the neighboring institutions may be admitted to course work at Duke University. All inter-institutional registrations involving extra-fee courses or special fees required of all students will be made at the expense of the student and will not be considered a part of the Duke University tuition coverage.

Identification Cards. Graduate students are issued two-part identification cards which they should carry at all times. The cards are the means of identification for library privilege, university health services, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee.

The cards are not transferrable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of this card immediately to the Registrar's Office. The cost of a new ID card is $5.

Grades. Grades in the Graduate School are as follows: *E*, *G*, *S*, *F*, and *I*. *E* (exceptional) is the highest mark; *G* (good) and *S* (satisfactory) are the remaining passing marks; *F* (failing) is below passing; and *I* (incomplete) indicates that some portion of the student's work is lacking, *for an acceptable reason*, at the time grades are reported. The instructor who gives an *I* for a course specifies the date by which the student must have made up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of *F* is normally entered upon the student's record. The grade of *Z* indicates satisfactory progress at the end of the first semester of a two-semester course. It will be changed to whatever grade is appropriate upon the completion of the course. A grade of *F* in a major course normally occasions withdrawal from a degree program not later than the end of the ensuing semester or term; a grade of *F* in any other course occasions academic probation.

Courses Primarily for Undergraduates. Students granted provisional admission and others whose preparation is found deficient may on occasion be required, as part of their program, to take undergraduate courses as prerequisites to continued graduate study. Undergraduate courses thus taken and others elected by the student will carry no graduate credit.

In exceptional cases, 100-level courses *outside the major department* may be taken for graduate credit to a maximum of two one-semester courses or one year course not exceeding a total of 8 units, when approved by the directors of graduate studies in the major department and in the department in which the course is listed, and by the supervisor of the program. In order to receive credit for any such undergraduate work, the graduate student must earn a grade of at least *B*. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course.

Withdrawal from a Course. For permissible changes during the first four weeks after the registration date, see Change of Registration. If a course is dropped without the necessary approval, the permanent record will list the course as *Dropped Unofficially, F*. If a course is dropped after the four-week period, status of the student at the time of withdrawal from the course will be determined and indicated on the permanent record as *Withdrew Passing* (*WP*) or *Withdrew Failing* (*WF*).

Interruption of Program and Withdrawal from the Graduate School. The University reserves the right, and matriculation by the student is a concession of this right, to request the withdrawal of any student whose academic performance at any time is not satisfactory to the University. If a student wishes for any reason to withdraw from the Graduate School, he should notify both the director of graduate studies in his major department and the Dean of the Graduate School prior to the date of his expected withdrawal. (For refunds upon withdrawal, see the section on Tuition and Fees.)

Students who find it necessary to interrupt their program of study for a longer period than a summer vacation should, before departure, leave with the Graduate School Office a statement of the reason for interruption, mailing address, and expected date of return. If they are subject to registration *in absentia*, as most students are, they should arrange for such registration before departure. Even if they are among the few whose program interruption qualifies them for registration exemption (see special exceptions under section on Course

Load), they should be sure to make official arrangements for their program interruption before their departure.

A foreign student who, after successfully completing a minimum of one semester's graduate study, must withdraw for the purpose of returning home before the completion of a graduate program may, with the approval of his major department, request the Dean to issue him a Certificate of Graduate Study.

Size and Make-up of Classes. Classes which carry graduate credit are limited in size to thirty students. In exceptional cases this regulation may be modified, but only by permission of the Dean of the Graduate School. Courses numbered from 200 through 299 may have not only graduate students enrolled but also an unspecified number of sophomores, juniors, and seniors, provided the undergraduates have the approval of both the course instructor and the director of graduate studies. Undergraduate students are not permitted to enroll in 300-level courses.

Language Requirements. Although individual departments have the right to establish their own minimal requirements (see individual departmental sections in this *Bulletin*), the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. degree may be waived in individual cases or with respect to all students in a given department, provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the students concerned. The languages usually taken are French, German, and Russian. A student may substitute for any one of these another language which has a definite relation to his degree program and for which an examination can be provided. A foreign student whose native language is not English may request that the director of graduate studies in his department ask permission of the Dean of the Graduate School to offer English for the foreign language required in his program.

To avoid unnecessary delays, prospective students should anticipate the language requirement of their degree programs. For example, students whose programs call for a knowledge of French, German, Russian, or Spanish are urged to take the appropriate Educational Testing Service (ETS) Graduate School Foreign Language Test prior to registration. It should be noted, however, that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language examinations more than six calendar years old will not be accepted toward fulfilling the language requirement.

Meeting the Requirement. The foreign language requirement may be satisfied in the following ways:

1. The student may take one of the ETS examinations administered to undergraduate and graduate students at many national centers (including the Duke University Counseling Center). The examination may be taken no longer than six years before the preliminary examination.

2. With the permission of the Dean of the Graduate School, the director of graduate studies may request transfer acceptance of a language examination passed prior to the student's enrollment at Duke. The student should request that a transcript or other certification that the language was passed be sent to the Graduate School for approval. Requirements are (*a*) that only one language of a doctoral requirement may be met in this way, (*b*) that the other institution offers a doctoral program in the student's major and the examination would have



met a doctoral requirement there, and (c) that the examination was passed no more than five years before first registration here.

3. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

4. In special circumstances, a reading examination in any foreign language may be administered by a qualified member of the faculty under a procedure specified by a department and approved by the Dean and the Executive Committee of the Graduate Faculty.

Requirements for Foreign Students. Foreign students whose native language is not English are, during their first registration period, required to take a test for minimum competence in English. Such students with the approval of the director of graduate studies in their major department, may request permission of the Dean of the Graduate School to substitute English for the one foreign language required in the master's or doctoral program. (See Admission Procedure for Foreign Students.)

Special Reading Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week: French during the fall semester and occasionally in the spring semester, German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses. Undergraduates may not enroll in these special courses during the academic year but may register in the summer with permission of the Dean of the Graduate School, provided space is available after graduate students have been enrolled.

Undergraduate Language Courses. Graduate students receive no credit for language courses numbered below 200.

Commencement

At commencement exercises in May, degrees are awarded to students who have completed all degree requirements by the end of either of the two regular semesters of the academic year. Students who complete all degree requirements by the end of a summer term become eligible to receive diplomas dated September 1. No commencement exercises are held for awarding September degrees, and diplomas are mailed after final approval by the Academic Council and Trustees of the University.

Standards of Conduct

Duke University expects and will require of all its students cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as currently in effect or, as from time to time, are put into effect by the appropriate authorities of the University.

Judicial Code and Procedures. In the spring of 1971, the Graduate School community ratified and adopted the following official judicial code and procedures:

I. Graduate School Judicial Code and Procedures

A. A student, by accepting admission to the Graduate School of Duke University, thereby indicates his willingness to subscribe to and be governed by the rules and regulations of the University as currently in effect or from time to time put into effect by the appropriate authorities of the University, and he indicates his willingness to accept disciplinary action, if his behavior is adjudged to be in violation of those rules or in some way unacceptable or detrimental to the University. However, a student's position of responsibility to the authorities and the regulations of the University in no way alters or modifies the responsibilities that are his in relation to civil authorities and laws.

B. A graduate student at Duke University stands in a primary and unique relation of responsibility to the faculty in his major department, the faculty upon whose recommendation a graduate degree will or will not be awarded to the student. In matters which involve or may affect the student's intellectual or professional life, the student is directly responsible to this department and its representatives, and such matters should primarily be handled by the department.

C. Actions which appear to conflict with University-wide rules and regulations will fall under jurisdiction of the University Judicial Board.

D. A student may elect to have the Dean of the Graduate School hear matters related to the student's conduct in addition to or instead of faculty members from the student's major department, or he may elect to have such matters reviewed and judged by a judicial board instead of the Dean of the Graduate School or members of the faculty in his major department. (The constitution and procedure of the judicial board are detailed below under "The Graduate School Judicial Board.")

E. The Director of Graduate Studies in the student's major department may request that a student's actions be reviewed by the Judicial Board or by the Dean of the Graduate School.

II. The Graduate School Judicial Board

A. *Composition.* The Graduate School Judicial Board shall have five members, serving for a period of two years: two students selected from the student body, two members of the Graduate Faculty appointed by the Executive Committee of the Graduate School, and one Associate or Assistant Dean appointed by the Dean of the Graduate School. The Board shall elect one of its members as Chairman. The Board shall have at its service a recording secretary to keep minutes of the hearings and of the Board's actions in a permanent, confidential record book. The Board will be constituted in order to hear cases in which the accused is a student currently enrolled in the Graduate School and which have been referred to it by the Director of Graduate Studies in the student's department, by the Dean of the Graduate School, or by the student himself.

B. *Preliminary Procedures.* If a student requests a hearing by the Judicial Board he must do so in writing, allowing its chairman at least 72 hours to convene the Board. In addition, the chairman shall not convene the Board until 72 hours after he had been asked to convene the Board.

It is the responsibility of the Chairman of the Judicial Board fully to inform its members concerning the case and the reasons the case has been referred to the Board. In addition, he shall prepare a written summary of this information for the Board, the Dean, and the student.

C. *Procedural Safeguards for the Hearing.* The Accused has the right to challenge on the grounds of prejudice any member of the Judicial Board. If the Board decides to excuse one of more of its members for reasons given by the Accused, it shall consult with the Dean about the need for replacements.

The Accused may choose an Advisor to assist him in his defense. He may also produce witnesses (including no more than two character witnesses), introduce documents, and offer testimony in his own behalf.

A person having direct knowledge relevant to a case being heard by the Board is a material witness. The Judicial Board may request the appearance of material witnesses. The Board shall also request, upon written request of the Complainant or the Accused, the appearance of material witnesses. Witnesses shall be notified of the time, place, and purpose of their appearance.

The Accused has the right to examine the written statement of any witness relevant to his case at least 72 hours before the hearing. He has the right to be faced with any witness who has given a statement relevant to his case at the hearing if the witness's attendance can be secured.

The hearing will be conducted in private unless the Accused requests an open hearing. If any objection is raised to conducting an open hearing in any particular case, the Judicial Board shall decide the issue by majority vote. If the decision is made not to hold an open hearing, the Accused shall be informed in writing of the reasons for the decision.

The Judicial Board shall consider only the report of the chairman, documents submitted into evidence, and the testimony of witnesses at the hearing in reaching its decisions.

D. *Conduct of the Hearing.* The hearing of any case shall begin with a reading of the charge by the chairman in the presence of the Accused. The Accused shall then plead guilty or not guilty or move to terminate or postpone the hearing. The Accused may qualify a plea, admitting guilt in part and denying it in part.

The Accused may not be questioned for more than one hour without recess.

At any time during the hearing, the Accused or the Judicial Board may move to terminate or to postpone the hearing or to qualify his plea or to modify its charge.

Pending verdict on charges (including appeal) against the Accused, his status as a student shall not be changed, nor his right to be on campus or to attend classes suspended, except that the Chancellor or Provost may impose an interim suspension upon any member of the University community who demonstrates, by his conduct, that his continued presence on the campus constitutes an immediate threat to the physical well-being or property of members of the University community or the property or orderly functioning of the University.

E. *Sanctions and the Verdict.* The Graduate School Judicial Board shall have the power to impose the following penalties: expulsion, dismissal from the University with the recommendation that the person never be readmitted; Suspension, dismissal from the University and from participation in all University activities for a specified period of time, after which the student may apply for readmission; Disciplinary Probation, placing the student on a probationary status for a specified period of time, during which conviction for violation of any regulation may result in more serious disciplinary action; Restitution, payment for all, or a portion of property damage caused during the commission of an offense. Restitution may be imposed by itself or in addition to any of the other penalties.

The Judgment shall consist of a finding of guilty or not guilty of the charge and, when the Accused is found guilty, a statement of the punishment assessed. On all questions, including the verdict and the finding of guilty or not guilty, the Board shall be governed by a majority vote.

The Judicial Board may decide to rehear a case in which significant new evidence can be introduced. In addition, the defendant may request an appeal.

F. *Appeals.* The appellant may submit to the Dean a written statement containing the grounds for his appeal and his arguments. In such cases, the Dean should determine if the appeal should be granted, and he can hear the case himself, or refer it to the appropriate faculty in the student's department or to the Judicial Board.

An appeal shall be granted on the following grounds: procedural error substantially affecting the rights of the Accused; incompatibility of the verdict with the evidence; excessive penalty not in accord with "current community standards"; new evidence of a character directly to affect the judgment but on which the original tribunal had refused a new hearing.

III. Amendment and Construction

This Judicial Code and Procedure and this constitution and procedure for the Graduate School Judicial Board may be amended at any time with due notice or publication by consent of the Dean, the Executive Committee, and the graduate students. Questions and problems not answered or anticipated by the foregoing may be resolved by the use of other existing institutions or by amendment.



Study in the Summer



Programs Offered

The 1975 Summer Session of Duke University will consist of three terms. The first term will begin on May 13 and will end on June 14. The second term will begin on June 16 and will end on July 17. The third term will begin on July 18 and will end on August 19.

Graduate students who wish to work toward advanced degrees in the summer session, particularly in chemistry, economics, education, English, history, mathematics, religion, sociology, and zoology, will find a selection of courses offered by members of the Duke faculty and by visiting professors. Other departments ordinarily offering work leading to the A.M. degree are botany, political science, and psychology. Thesis research for advanced graduate students is available also in most other departments, such as engineering, forestry, and physics.

Students who wish to be admitted to the Graduate School for work in the summer session should make application to the Dean of the Graduate School, as well as to the Director of the Summer Session, and should return the completed application, with supporting documents, before April 15 for admission to Term I; before May 15 for admission to Term II; and before June 15 for admission to Term III. (See the section on Admission.)

Regulations Regarding Summer Work

No graduate student may register for more than 6 units of credit in one summer session term. All of the work required for the master's degree must be completed within six years of the date of matriculation. No residence credit can be accepted toward the requirement for the Ph.D. degree for work completed during the summer sessions. Students who complete during the summer session the work required by the University for an advanced degree will be granted the degree in September.

The *Bulletin of the Summer Session*, containing information about graduate courses, may be obtained by writing to the Director of the Summer Session, Duke University, Durham, North Carolina 27706.



Courses of Instruction



Course Enrollment

In general, courses with odd numbers are offered in the fall semester, those with even numbers in the spring semester. Double numbers separated by a hyphen indicate that the course is a year course and usually must be continued throughout the year if credit is to be received. A student must secure written permission from the instructor in order to receive credit for either semester of a year course. Double numbers separated by a comma indicate that although the course is a year course, credit may be received for either semester without special permission. Ordinarily, courses which bear no date are offered every year.

Note: In each department the number 399 is reserved to designate special (individual) readings in a specified area and supervised by a regular member of the graduate staff, with credit of one to three units each registration, only one course per registration, and nine units maximum in three successive registrations. The course is restricted to resident master's and doctoral programs, must have a completion exercise, and must carry a grade.

Anatomy

Professor Robertson, *Chairman* (Room 466, Sands Building); Assistant Professor Adelman, *Director of Graduate Studies* (Room 270, Sands Building); Professors Everett, Moses, and Peele; Associate Professors Cartmill, Counce, Duke, Hylander, Longley, and Reedy; Assistant Professors Bergeron, Blake, Corless, Erickson, Fletcher, Hall, Johnson, Kay, Mahaley, Strickler, and Tyrey; Lecturer Diamond

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core anatomical sciences course (Anatomy 301) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the Anatomy Department. Laboratories within the department are equipped for and actively support research in several areas. Some idea of the opportunities for degree research may be gleaned from the description of Anatomy 312. For further information contact the Director of Graduate Studies.

207. Human Anatomy. A lecture-laboratory discussion course that examines human morphology and the fundamental relationships among the neurologic, musculo-skeletal, cardiovascular, gastrointestinal, respiratory, renal, and reproductive systems. The course includes cadaveric presentations of every major region of the human body. Intended primarily for students in allied health programs. Prerequisite: permission of instructor. Credit variable; maximum 3 units. *Blake or Kay*

208. Anatomy of the Trunk. Designed for Ph.D. candidates in anatomy as well as general practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisite: core course in anatomy. Number of students arranged by staff. 2 units. *Duke*

215. Contractile Processes. (Also listed as Physiology 216.) 3 units. *Reedy, Anderson, Jobsis, or Johnson*

216. Biological Psychology. See course description for Psychology 216. (Also listed as Psychology 216.) *Diamond*

217. Structure and Function of Visual Photoreceptors. A detailed study of available structural, biochemical, spectroscopic, and physiological data from retinal photoreceptors. Emphasis on molecular structure of vertebrate photoreceptor membranes, effects of bleaching on rhodopsin molecule, and initiation of neural information after photon absorption. Lectures, seminars, and demonstrations. Complements Anatomy 276. Offered fall, 1975, and alternate years thereafter. Prerequisites: Anatomy 276, 280, 286, 290, 301, Zoology 246, physical chemistry, or consent of instructor. Credits to be arranged; maximum 4 units. *Corless*

219. Molecular and Cellular Basis of Development. A multidisciplinary approach stressing the molecular, cellular, and genetic processes involved in development and differentiation in pro- and eukaryotes. Topics include: initiation of development, morphogenesis, developmental genetics, differentiation, and nuclear-cytoplasmic interactions in development. (Also listed as Biochemistry 219, Microbiology 219, Pathology 219, and Physiology 230.) 3 units. *Counce, Johnson, Kaufman, McCarty, or Padilla*

219S. Seminar. Optional seminar offered in conjunction with Anatomy 219. Students prepare and present seminar topics directly related to specific subjects discussed in Anatomy 219. Prerequisites: enrollment in Anatomy 411 and permission of instructors. 1 unit.

231. Human Evolution. Evolutionary biology of the primates. Anatomical and behavioral adaptations and phylogeny of fossil and living primates including *Homo sapiens*. Prerequisite: Anthropology 93 or equivalent. (Also listed as Anthropology 231.) 3 units. *Cartmill*

238. Function and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anatomy 231 (Anthropology 231) or equivalent, or consent of instructor. (Also listed as Anthropology 245.) Offered spring, 1975, and alternate years thereafter. 3 units. *Hylander or Cartmill*

240. Mechanisms of Biological Motility. Discussions, based on extensive readings, on the ultrastructure and biochemistry of biological motile systems. Introductory discussions of muscle contraction and sperm-cilia-flagella will

form the basis for subsequent consideration of such weekly topics as amoeboid motion, fibroblast motility, protoplasmic streaming, mitosis, particle saltations, etc. Emphasis placed on defining similarities between systems with different phenomenologies of motion. Ends with a series of brief student seminars on topics from areas not covered in the principal seminars. Prerequisite: written permission of the instructor. Enrollment minimum 4; maximum 10. 3 units. Offered spring, 1975, and alternate years thereafter. *Adelman*

246. The Primate Fossil Record. (Also listed as Anthropology 246.) 3 units. *Cartmill or Kay*

261. History of Generation and Mammalian Reproduction. Theories of generation and of historical development of present-day concept of mammalian reproductive processes. Prerequisite: consent of instructor. Offered fall, 1975, and alternate years thereafter. (Alternates with Anatomy 263.) 1 unit. *Duke*

263. History of Anatomy. The lives and contributions of the founders of anatomy, Aristotle to the twentieth century. Prerequisite: consent of instructor. Offered fall, 1974, and alternate years thereafter. (Alternates with Anatomy 261.) 1 unit. *Duke*

264. Mammalian Embryology and Developmental Anatomy. Study of early embryology and organology of mammals, using the rat as the basic form, supplementing it with other mammalian forms, including primates. Prerequisites: one year of zoology and consent of instructor. 4 units. *Duke*

265. Seminar in Chromosome Biology. (Also listed as Zoology 265.) 2 units. *Moses and Nicklas (Zoology)*

266. Seminar in Chromosome Biology. See course description for Zoology 265. (Also listed as Zoology 266.) *Moses and Nicklas (Zoology)*

276. Neuroanatomical Basis of Sensory Physiology. Original papers read and discussed which are concerned with the neuroanatomical substrates underlying sensory processing in the auditory and visual systems. Prerequisite: permission of instructor. Offered spring, 1975, and alternate years thereafter. (Also listed as Psychology 276.) 3 units. *Hall*

280. Structure and Assembly of Macromolecules. Lectures and conferences on the structure of biological macromolecules and on the mechanisms of assembly of organized macromolecular aggregates such as are found in viruses and cellular organelles. Emphasis on the results of electron microscopic, X-ray diffraction, and optical analyses. Prerequisites: microscopic anatomy or cytology, or equivalent, and permission of instructor. Offered spring, 1977, and alternate years thereafter. (Alternates with Anatomy 286.) 3 units. *Longley, Adelman, Corless, Erickson, Moses, Reedy, or Robertson*

286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology. Lectures and laboratories on methods of ultrastructure research. Fundamentals of optics; the light microscope, phase, polarizing, and interference microscopy. Basics of electron microscopy, staining, sectioning, and replication techniques. Optical and computer image processing. Introduction to X-ray diffraction theory and apparatus in structure determination. Prerequisites: microscopic anatomy or cytology (or equivalent), calculus and one year each of physics and general chemistry; permission of instructor. Offered spring, 1976, and alternate years thereafter. (Alternates with Anatomy 280.) 4 units. *Longley, Erickson, Moses, Reedy, or Robertson*

288. Seminar on the Role of the Cell in Development and Heredity. Topics of current interest and controversy. Prerequisites: a course in genetics and permission of instructor. (Also listed as Zoology 288 and under the University Program in Genetics.) 2 units. *Counce*

291. Special Topics in Nerve Ultrastructure. Each student chooses a topic, such as ultrastructure of synapses, or sensory nerve endings including the retina, of auditory nerve, of simple nerve nets, or morphological correlates of learning. Each student pursues his topic in the library during the first half of the semester with guidance from the instructor in order to prepare a detailed paper. The second half of the semester is devoted to seminar presentations and discussions of the selected topics. Enrollment: minimum 5. 2 units. *Robertson*

300. Gross Anatomy. Gross anatomy for physical therapy students. Credit to be arranged; maximum, 8 units. *Blake or Kay*

301. Gross Human Anatomy, Microscopic Anatomy, and Neuroanatomy. Gross anatomy includes complete dissection of a cadaver; laboratory work is supplemented by conferences which place emphasis upon biological and evolutionary aspects. Microscopic anatomy will emphasize the cell, its generalized structural and functional organization down to the molecular level, and differentiations of the cell in various organs and tissues. Students will be introduced to light and electron microscopic and diffraction methods for investigating biological structure. Neuroanatomy will first present the gross and basic intrinsic anatomy of the central nervous system. Later, specific systems will be emphasized: various sensory and motor, limbic-hypothalamic, and cerebral-associated mechanisms. Clinical presentations will be offered. Prerequisites: adequate background in biology, including comparative anatomy and embryology, and written permission of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. Hours and credit by arrangement; maximum, 8 units. *Staff*

303. Neuroanatomical Basis of Behavior. Basic neuroanatomy and its physiologic and functional correlates. 3 units. *Hall or Peele*

312. Research. Individual investigations in the various fields of anatomy. Laboratories in which a student may work include: three electron microscopy laboratories headed by Moses, Reedy, and Robertson with emphasis respectively on the fine structure and cell biology of chromosomes and associated structures, molecular structure and function of muscle, and biophysical studies of cell membranes and nervous tissue; physical anthropology laboratories and the Primate Facility under Bergeron, Cartmill, Hylander, and Kay concentrating on biomechanics, cytogenetics, comparative anatomy, and primate evolution and behavior; neuroanatomy laboratories under Peele, Hall, and Diamond emphasizing structural correlates of behavior and learning; neuroendocrinology laboratories under Everett, Blake, Fletcher, and Tyrey emphasizing cellular, physiological, and ultrastructural studies of the reproductive functions of the pituitary gland; comparative anatomy laboratories under Duke and Strickler focusing respectively on ovarian structure and function and on the morphology and behavior of bats; developmental biology laboratories under Counce and Johnson with emphasis on insect and amphibian morphogenesis and the role of cell membrane contact phenomena in differentiation; a cell biology laboratory under Adelman studying the biochemistry and phenomenology of primitive motility; and molecular structure laboratories under Longley, Erickson, and Corless using a combination of electron microscopy, X-ray diffraction, and optical and computer methods of image analysis to study respectively fibrous proteins, mi-

crotubules, and photoreceptor membranes. Credits to be arranged; maximum, 6 units. Permission of staff required. *Staff*

313, 314. Anatomy Seminar. Regular meeting of graduate students and staff in which current research problems in anatomy will be presented. 1 unit per semester. *Staff*

334. Topics in Physical Anthropology. Reading and discussion of recent research. Prerequisite: Anatomy 231 (Anthropology 231 and Zoology 231). (Also listed as Anthropology 334.) Offered spring, 1975, and alternate years thereafter. 3 units. *Cartmill and Staff*

340. Tutorial in Advanced Anatomy. Topics for intensive reading and discussion will be chosen according to the student's interests, related to basic problems in biophysics, cytology, endocrinological control, growth and development, neuroanatomy, physical differentiation, and evolutionary origins of functional micro-systems. Maximum enrollment—8. Prerequisite: permission of instructor. 3 units. *Staff*

344. Advanced Neuroanatomy of Sensory and Motor Mechanisms. The course will involve consideration of classic and modern concepts of somatic and special sensory systems and of somatic and visceral motor systems. Clinical correlations of basic neuroanatomy will be included. Minimum enrollment—5; maximum—20. 3 units. *Peele*

354. Research Techniques in Anatomy. A preceptorial course in various research methods in anatomy. An interested student might engage in research in one of the following: anthropology, electron microscopy, X-ray diffraction, chromosome analysis, developmental biology, fetal physiology, primate behavior, primate anatomy, and stereotactic approaches to neuroendocrinology and neuroanatomy. Other topics may be arranged. Prerequisite: permission of instructor. Units to be arranged. *Staff*

418. Reproductive Biology. See course description for Physiology 418. (Also listed as Physiology 418.) 2 units. *Anderson, Blake, Fletcher, Schomberg, or Tyrey*

Anthropology

Professor Friedl, *Chairman and Director of Graduate Studies* (344 Sociology-Psychology Building); Professors Fox and LaBarre; Associate Professors Apte, Cartmill, Hylander, O'Barr, and Rosen; Assistant Professors Boon, Casson, Quinn, and Smith

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test.

Candidates for the Ph.D. degree must demonstrate a general competence in four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more of these sub-fields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the course work required for the Ph.D. degree by advanced work in anatomy, economics, psychology, sociology, zoology, or other disciplines relevant to a student's program.

Further details of the graduate program in anthropology, the departmental facilities, the staff, and various stipends available are described in the *Guide-*

lines for Graduate Students in Anthropology which may be obtained from the Director of Graduate Studies, Department of Anthropology.

For Seniors and Graduates

210. Linguistic Anthropology: Theory. Examination and comparison of predominant schools of language study—comparative-historical, structural, transformational, stratificational, and generative semantics. 3 units. *Apte or Casson*

211. Linguistic Anthropology: Ethnography of Communication. Verbal and non-verbal communication from linguistic and anthropological perspectives with emphasis on synchronic and diachronic aspects of communication, development of sociolinguistic theory and its application to intra- and intercultural communicative processes. 3 units. *Apte or Casson*

220. Society and Culture in India. The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. 3 units. *Fox or Apte*

222. Topics in African Anthropology. Research problems illustrated through ethnographic studies of African societies. 3 units. *O'Barr*

231. Human Evolution. See course description for Anatomy 231. (Also listed as Anatomy 231.) *Cartmill*

242. Topics in Prehistory. Anthropological issues derived from archeological and early historical investigations. 3 units. *Staff*

243. Theory and Method in Archaeology. Techniques of geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses applied to problem areas in archaeology—human cultural origins, Paleolithic and post-Pleistocene readaptations, and origins of agriculture and civilization. Prerequisite: permission of the instructor. 3 units. *Staff*

244. Primate Behavior. Examination of the social behavior of prosimians, monkeys, and apes in an attempt to understand the evolutionary development of the primate order and the origin of man. 3 units. *Staff*

245. Functional and Evolutionary Morphology of Primates. See course description for Anatomy 238. 3 units. *Hylander or Cartmill*

246. The Primate Fossil Record. Evolution of man and primates as inferred from the fossil remains. Prerequisite: Anatomy 231 (Anthropology 231, Zoology 131) or equivalent, or permission of instructor. 3 units. *Cartmill*

249. Topics in Economic Anthropology. 3 units. *O'Barr, Quinn, or Smith*

250. The Anthropology of Cities. Organization and behavior of men in urban centers analyzed from an evolutionary perspective; cross-cultural analysis of cities and their varying roles. 3 units. *Fox*

251. Ethnography of Humor. Examination of theoretical framework, research methods, and data-collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94 or permission of instructor. 3 units. *Apte*

259. Linguistic Anthropology: Language Acquisition. Biological basis of

human linguistic capacity, major theoretical positions in linguistics, acquisition of semantics, and syntax and phonology in English and other languages. Prerequisite: permission of the instructor. 3 units. *Casson*

262. Law and Anthropology. Adjudication and dispute settlement in primitive and small-scale societies. Western legal developments compared with those of new nations. American legal problems from the anthropological perspective. 3 units. *O'Barr or Rosen*

263. Primitive Art and Music. A comparative ethnological study of non-European art and music; sufficient technical background will be provided for nonspecialist students. 3 units. *LaBarre*

264. Primitive Religion. The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. 3 units. *LaBarre*

265. Personality and Society. The sociology and social psychology of human personality, its origins in the primary group, its nature and varieties, and its integrations into secondary group institutions. 3 units. *LaBarre*

266. Personality and Culture. The influence of culture patterns and social institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comprehensive anthropological materials will be drawn upon. 3 units. *LaBarre*

267. Cognitive Anthropology. Theoretical and methodological developments in the study of taxonomies, naturally occurring categories, information-processing rules, decisions, and belief systems. Psychological testing of non-Western people; effects of schooling. 3 units. *Quinn*

268. Law and the American Indian. Survey of the legal status and problems of the contemporary American Indian. Topics include the basis and extent of tribal sovereignty, the relation of states and their Indian citizens, treaties and Indian claims actions, the legal context of economic development, and the legal position of Eastern American Indians. 3 units. *Rosen*

270. Ethnographic Field Methods. Research strategies and techniques for field research; participation in a field project in a local community. 3 units. *Casson, O'Barr, or Quinn*

271. Methods of Data Analysis. Quantitative analysis of anthropological data. 3 units. *Quinn*

275. Rank, Power, and Authority in Pre-Industrial Societies. The role and development of social, economic, and political stratification in specific societies in Oceania, Africa, and the New World. 3 units. *Fox*

276. Analysis of Kinship Systems. Primitive relationship categories as related to legal norms and social groupings. Theoretical issues and contrasting approaches to the analysis of social classification terminologies. 3 units. *Casson*

278S. Special Topics in Political Anthropology. Current research problems. Topic(s) will change each semester. 3 units. *O'Barr or Quinn*

280S, 281S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Prerequisite: permission of the instructor. 3 units per semester. *Staff*

291, 292. Anthropological Theory. Theoretical, methodological, and comparative issues in anthropology. 3 units per semester. *Boon, Fox, or Quinn*

For Graduates

330, 331. Seminar in Anthropology. A seminar for advanced students who wish to pursue individual studies in social and cultural anthropology. Offered both semesters. 1 to 3 units per semester. *Staff*

334. Topics in Physical Anthropology. See course description for Anatomy 334. (Also listed as Anatomy 334.) 3 units. *Staff*

335, 336. Linguistic Theory and Methods. Basic course for graduate students in the anthropology graduate program. 3 units. *Apte and Casson*

393. Individual Research in Anthropology. A course for the student preparing the A.M. thesis or the Ph.D. dissertation. Supervision and guidance of intensive research on a problem approved by the student's departmental advisory committee. 3 units. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

410. Seminar in the Government, History, and Social Structure of India and Pakistan. 3 units. *Fox and Staff*

Art

Professor Covi, *Chairman;* Professor Markman, *Director of Graduate Studies;* Professors Jenkins, Mueller, and Sunderland; Assistant Professor Lichtenstein; Lecturer Langedijk; Visiting Part-time Professor Huemer

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. The candidate must also pass a written comprehensive examination testing his knowledge of art history and pertinent bibliographical resources.

217.* **Aegean Art. A study of the problems of Aegean art as the forerunner of Greek art and in relation to the contemporary civilization of the eastern Mediterranean world. 3 units. *Markman*

218.* **Early Greek Art. A study of the problems of the origin and development of Greek art in the Geometric period to the end of the Archaic. 3 units. *Markman*

233.* **Early Mediaeval Architecture. The development of religious architecture from the time of Constantine to the end of the First Romanesque style in the third quarter of the eleventh century. 3 units. *Sunderland*

*Offered upon demand.

237. French Renaissance Art. Sixteenth century painting and sculpture in France with special emphasis on Italian influences. Prerequisites: some knowledge of Italian Renaissance art and the ability to read French, or consent of the instructor. 3 units. *Jenkins.*

239. Seminar in Architecture of Britain. A summary of recent archaeological activity in the British Isles and a survey of medieval building, the course deals principally with changing architectural problems and their solutions from the advent of the Renaissance onward. Attention is given to the interests of students majoring in history or literature. 3 units. *Staff*

240. Seminar in Architecture of North America. A study illustrating the transplantation of European architectural customs since the sixteenth century; the time-lag in transit and acceptance of later European developments; the gradual assumption of confident independence in design; and the emergence of international leaders in the United States. 3 units. *Staff*

241. Problems in Latin American Art. The architecture, painting, sculpture, and other arts, with the emphasis on colonial architecture of Central America. Open to students who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. 3 units. *Markman*

245, 246. Problems in Italian Renaissance Painting. Concentrated study of painting in one or more centers outside Florence. Prerequisite: consent of the instructor. 3 units each semester. *Huemer*

247. Problems in the History of Graphic Arts. Concentrated study of selected topics in the history of prints and drawings. 3 units. *Mueller*

248. Florentine Painting during the Renaissance. Prerequisite: consent of the instructor. 3 units. *Covi*

249. Problems in Pre-Columbian Art and Archaeology. Architecture, sculpture, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region. Prerequisite: consent of the instructor. 3 units. *Markman*

251-252. Research. A course designed to give instruction in methods used in the investigation of original problems. 6 units. *Staff*

253. Studies in Italian Renaissance Sculpture. Prerequisite: consent of the instructor. 3 units. *Covi*

255, 256. Iconological Problems. Study of subject matter and sources. 3 units per semester. *Langedijk*

257, 258. Problems in Modern Art. Selected topics in nineteenth and twentieth century European art, with emphasis on one or more major movements or masters. Prerequisite: consent of instructor. 3 units each semester. *Lichtenstein*

291, 292. Museology Seminar. Operation of a museum; instruction in exhibition and restoration techniques, as well as registration and the researching of art objects with a view to exhibition accompanied by scholarly catalogues. Prerequisite: consent of the instructor. 3 units each semester. *Staff*

293, 294. Special Problems in Art History. Individual study and research. 3 units each semester. *Staff*

399. Directed Reading and Research. 1 to 3 units. *Staff*

Asian Languages

The course is offered as an enrichment for students interested in the South Asian subcontinent and may be taken as a general elective by advanced undergraduate students. No major work is offered in Hindi-Urdu.

Hindi-Urdu 200-201. Special Studies in South Asian Languages. Intensive concentration in advanced Hindi reading and conversation, or specialized graded work in cognate South Asian languages necessary for the advanced student contemplating field work in South Asia. Prerequisite: consent of instructor. 6 units. *Staff*

For courses in Chinese and Japanese, see *Bulletin of Undergraduate Instruction.*

Biochemistry

Professor Hill, *Chairman* (Medical Sciences Building I); Professor Gross, *Director of the Genetics Division* (Medical Sciences Building I); Associate Professor Rajagopalan, *Director of Graduate Studies* (Medical Sciences Building I); Professors Fridovich, Guild, Handler,* Harris, Kamin, Kirshner, McCarty, and Tanford; Associate Professors Appel, Greene, Kaufman, Kim, Lynn, Reynolds, Sage, Siegel, and Webster; Assistant Professors Bell, Habig, Hall, Harriman, Kelley, Kredich, Lefkowitz, McKee, Richardson, Sullivan, and Wheat; Associates Bittikofer, Bonaventura, McCord, Nozaki, and Steinman

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcome, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, enzyme chemistry, and neurochemistry. The Division of Genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

204. Introductory Genetics. An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organization of the genetic material. Primarily for medical students, but graduate students may be admitted with the instructor's permission. (Also listed under the University Program in Genetics.) 3 units. *Gross and Others of the University Program in Genetics*

208. Laboratory Methods in Biochemistry. An advanced laboratory course that emphasizes current procedures, instrumentation, and experiments in biochemistry. Prerequisites: Biochemistry 293, 295, and 297, or equivalent. Offered only in the summer. 2 units. *Staff*

209-210. Independent Study. A tutorial designed for students who are interested in either a laboratory or a library project in biochemistry. Units to be determined. *Staff*

216. Molecular Genetics. Genetic mechanisms and their relationship to nucleic acids and their synthesis. Prerequisites: introductory courses in biochemis-

*On leave of absence.

try and genetics or consent of instructor. (Also listed under the University Program in Genetics.) 4 units. *Guild and Others of the University Program in Genetics.*

219. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Microbiology 219, Pathology 219, and Physiology 230.)

219. Optional laboratory offered in conjunction with the lecture. Techniques of organ and cell culture, chromosome morphology, and some electron microscopy as applied to development and differentiation. 2 units. *McCarty, Bolognesi, Harris, Johnson, and Kaufman*

219S. Seminar. Optional seminar in conjunction with Biochemistry 219.

220. Adaptations of Organisms to the Marine Environment. Basic concepts of biochemistry and variables in the marine environment which evoke adaptive responses. Adaptations at the molecular level are considered, and the general topic of biological fitness. Laboratory experiments utilize basic methods of biochemical analysis. Prerequisites: basic biology and chemistry and consent of instructor. 1 unit. *Bonaventura*

222. Structure of Biological Macromolecules. Introduction to the techniques of structure determination by X-ray crystallography and study of some biological macromolecules whose three-dimensional structures have been determined at high resolution. 2 units. *Kim or Richardson*

241. General Biochemistry. An introductory survey of fundamental aspects of biochemistry with emphasis on the structure of macromolecules, mechanism of enzyme action, metabolic pathways, biochemical genetics, and the structure and functions of special tissues. Designed for medical students; graduate students only with permission of instructor. 4 units. *Hill or Staff*

248. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, and nucleic acids and the metabolic interrelationships of these compounds. Prerequisite: organic chemistry. (Also listed as Botany 248 and Zoology 248.) 3 units. *Siegel or Kim*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. Given at Beaufort. 6 units. *Sullivan*

282. Experimental Genetics. Laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. Prerequisite: consent of instructor. (Also listed under the University Program in Genetics.) 2 units. *Hall and Others in the University Program in Genetics*

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed under the University Program in Genetics.) 1 unit. *Hall and Others of the University Program in Genetics*

286. Current Topics in Immunochemistry. The structure, function, and specificity of antibodies. Immunogenicity and tolerance with special emphasis on current theories of the diversity and synthesis of antibody molecules. 2 units. *Sage*

288. The Carbohydrates and Lipids of Biological Systems. The subjects will be considered in the following two general categories: (*a*) the relationship between chemical structure and biological function, and (*b*) biosynthesis and catabolism. 2 units. *Kaufman*

290. Bioenergetics. Biological mechanisms of transduction of energy (covalent, ionic, photonic, and electric) will be considered, using photosynthetic, oxidative, phosphorylative, and glycolytic systems as examples. Since many of the above processes occur in membranous systems, the role and function of membranes in these processes will also be considered. 2 units. *Lynn*

293. Macromolecules. The structures of biological macromolecules and their relations to biological functions. Prerequisites: physical chemistry equivalent to Chemistry 161-162. 4 units. *Hill, Kim, Richardson, or Tanford*

295. Enzyme Mechanisms. A study of current views of the modes of action of enzymes and of the techniques which are found most useful in elucidating these matters. Theory and practice will be given equal emphasis. 3 units. *Fridovich or Rajagopalan*

296. Biological Oxidations. A lecture, conference, and seminar course on the mechanism of electron transport and energy conservation in purified enzymes and in organized systems such as the mitochondrion, the endoplasmic reticulum, and the chloroplast. 2 units. *Kamin, Fridovich, Rajagopalan, and Siegel*

297. Intermediary Metabolism. The synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids will be discussed in detail with emphasis on energy transformation and metabolic interrelationships. 3 units. *Kirshner or Siegel*

299. Nutrition. This course examines the experimental basis for the identification and quantification of requirements for calories, macronutrients, and micronutrients—vitamins and minerals; the biochemistry of nutrition with the assessment of nutriture; and the biological effects of deficiency or excess of nutrients. The course seeks to define optimal nutriture and will search for factual bases for common beliefs on nutrition. Informal lectures and, if possible, student seminars. Prerequisite: a basic biochemistry course, the equivalent, or permission of instructor. 2 units. *Kamin*

302. Neurochemistry. Aspects of structure, function, and metabolism unique to the nervous system. Properties and interactions of neuroreceptors and nerve-muscle relationships. 3 units. *Kirshner, Kaufman, Bell, Appel, or Vanaman*

345, 346. Biochemistry Seminar. Required of all biochemistry students. 1 unit per semester. *Bell or Staff*

351, 352. Genetics Seminar. Required of all students specializing in genetics. (Also listed under the University Program in Genetics.) 1 unit per semester. *Hall and Others of the University Program in Genetics*

390. Biochemistry of Membranes. Physical and chemical properties of biological membranes. Properties of constituent lipids and proteins in relation

to membrane function. Prerequisite: Biochemistry 293 or its equivalent. 2 units. *Reynolds, Tanford, or Bell*

Botany

Professor Wilbur, *Chairman* (149 Biological Sciences Building); Associate Professor Searles, *Director of Graduate Studies* (257 Biological Sciences); Professors Anderson, Billings, W. Culberson, Hellmers, Johnson, Naylor, Philpott, Stone, and White; Associate Professors Antonovics, Barber, Boynton, Knoerr, and Strain; Assistant Professors Blankley and Christensen; Lecturer C. Culberson

Graduate work in the Department of Botany is offered leading to the A.M. (nonthesis), M.S. (thesis), and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

202. Phytoplankton Systematics. Taxonomy and classification of marine phytoplankton: general characteristics, phytogeography, life histories, and study techniques. Individual projects. 6 units. *Blankley*

203. Cytogenetics. Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variations, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. Laboratory optional, but limited to 12 students. 3 units. *Anderson*

203L. Laboratory in Cytogenetics. Techniques for chromosomal preparations for light microscopy. Mitotic and meiotic interpretations, determination of chromosome numbers, and karyotypic comparisons. Ordinarily to accompany Botany 203. 1 unit. *Anderson*

204. Marine Microbiology. The major groups of marine microorganisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in general biological science or botany. 6 units. *Blankley*

205. Anatomy. Intensive survey of vascular plant cell types, tissues, and organs, with emphasis on the modern application of anatomy to problems of systematics and phylogeny. Laboratories will include microtechnique. Special project and term paper stressing current techniques and literature required. Prerequisite: permission of instructor. 4 units. *White*

206. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations and for study of micro and ultrastructures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. (Also listed as Forestry 206.) 4 units. *Philpott*

207. Microclimatology. See course description for Forestry 204. (Also listed as Forestry 204.) 3 units. *Knoerr*

209. Lichenology. Morphology, systematics, and biological and ecological

implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. 3 units. *W. Culberson or C. Culberson*

210. Bryology. Morphological, systematic, and ecological characteristics of mosses and liverworts. 3 units. *Anderson*

211. Marine Phycology. An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. Summer session only. 6 units. *Searles*

212. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. 4 units. *Searles*

214. Biological Oceanography. See course description for Zoology 214. (Also listed as Zoology 214.) *Barber*

217. Environmental Instrumentation. See course description for Forestry 217. (Also listed as Forestry 217.) *Knoerr*

221. Mycology. Field and laboratory study of the vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in the local flora. Prerequisite: one year of biological science. 4 units. *Johnson*

225, 226. Special Problems. Students with adequate training may do special work in the following fields. Credit to be arranged. 1-4 units.

1. Cytology; Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Blankley*
5. Genetics. *Boynton*
6. Ecology. *Christensen*
7. Lichenology. *Culberson*
8. Physiology. *Hellmers*
9. Bacteriology; Mycology. *Johnson*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics of Flowering Plants. *Stone*
14. Ecology. *Strain*
15. Anatomy and Morphology of Vascular Plants. *White*
16. Systematics and Taxonomy of Vascular Plants. *Wilbur*

233. Microbiology. (Also listed as Microbiology 233.) 3 units. *Willett, Burns, Joklik, or Amos*

235. Evolutionary Systematics. See course description for Zoology 235. (Also listed as Zoology 235.) 3 or 4 units. *Bailey, Lundberg, and Stone*

236. Major Global Ecosystems. Study of a single global ecosystem such as arctic-alpine, desert, tropical rainforest, grassland, or coniferous forest including the place and effects of primitive and modern man. 3 units. *Billings*

242. Systematics. A general survey of the principles of vascular plant taxonomy, with practice in identification and collection. Lectures, laboratories, and field trips. Prerequisite: one year of biology. 4 units. *Wilbur*

245. Plant Diversity. An examination of the major groups of the living plants and a consideration of their evolutionary origins and phylogenetic relationships. 4 units. *Culberson and White*

246. Ecology. Intensive study of the environmental effects on growth and distribution of plants at the level of the individual, the population, and the ecosystem. A term paper will be required. Lectures, laboratories, and field trips. Prerequisite: permission of instructor. 4 units. *Billings, Christensen, or Strain*

248. Introductory Biochemistry. See course description for Biochemistry 248. (Also listed as Biochemistry 248 and Zoology 248.) 3 units. *Siegel*

250S. Plant Biosystematics. Examination of descriptive and experimental procedures used to assess systematic implications of vascular plant evolution. Laboratory, discussion, and exercises and field-oriented problems. Prerequisites: basic courses in systematics and genetics. 4 units. *Stone*

251. Physiology. Physiological processes in plants and their interrelationships. Lectures, laboratories, and readings. Prerequisite: permission of instructor. 4 units. *Naylor*

252. Plant Metabolism. The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. 4 units. *Naylor*

255. Plant Systematics. A survey of the principles of plant taxonomy. Prerequisite: Botany 52 or equivalent. 4 units. *Wilbur*

256. Physiological Role of Minerals and Water. Availability, uptake, transport, and function of minerals and water in plant growth. Prerequisite: Botany 151 or equivalent. 3 units. *Hellmers*

257. Principles of Plant Distribution. Interpretation of floristic and ecological plant geography. Prerequisite: Botany 156 or equivalent. 3 units. *Billings*

258. Physiology of Growth and Development. Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Prerequisites: Botany 151 or equivalent; organic chemistry is recommended. 3 units. *Naylor*

258L. Physiology of Growth and Development. Optional laboratory supplementing Botany 258. 2 units. *Naylor*

259. The Environment. Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 156 or equivalent. 3 units. *Billings*

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. 3 units. *Strain*

267. Concepts and Methods of Plant Synecology. Introduction to the plant communities of North Carolina. Prerequisites: Botany 152 and 246, or equivalent, and consent of instructor. 4 units. *Christensen*

268S. Quantitative Plant Ecology. Experimental design, statistics, and analysis of pattern, population growth, diversity, community composition, and ecosystem dynamics. Prerequisites: statistics and Botany 246 or equivalent and consent of instructor. 3 units. *Christensen*

280. Principles of Genetics. Introduction to the structure and properties of genes and chromosomes and to the evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equiva-

lent. (Also listed as Zoology 280 and under the University Program in Genetics.) 3 units. *Antonovics, Boynton, or Gillham*

285S. Population Genetics. (Also listed as Genetics 285.) 3 units. *Antonovics*

286. Evolutionary Mechanisms. See course description for Zoology 286. (Also listed as Zoology 286 and under The University Program in Genetics.) 3 units. *Antonovics or H. Wilbur*

287. Quantitative Genetics. Analysis of genetic variation in continuous traits. Models of continuous variation; genetic, environmental, and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: Botany 280 or equivalent and consent of instructor. 3 units. *Antonovics*

295S, 296S. Seminar in Botany. Credits to be arranged. *Staff*

300. Tropical Biology: An Ecological Approach. Highly intensive, field-oriented course conducted in Costa Rica under auspices of Organization for Tropical Studies. For additional information refer to Special and Cooperative Programs in this *Bulletin*. 6-8 units. *Staff*

305. Tropical Studies. Highly intensive, field-oriented courses conducted in Latin America under auspices of Organization for Tropical Studies. For additional information refer to Special and Cooperative Programs in this *Bulletin*. 4-8 units. *Staff*

344S. Advanced Topics in Micrometeorology and Biometeorology. See course description for Forestry 344. (Also listed as Forestry 344.) *Knoerr*

359-360. Research in Botany. Individual investigation in the various fields of botany. Credits to be arranged. *All Members of the Graduate Staff*

The University Program in Genetics. Genetics courses offered by the Botany Department are an integral part of this interdepartmental program. Refer to the announcement in this *Bulletin* under the University Program in Genetics for description of the offerings.

204, Introductory Genetics; 215, Bacteriophage: Structure and Function; 216, Molecular Genetics; 236, Human Genetics; 280, Principles of Genetics; 282, Experimental Genetics; 284, Current Topics in Genetic Mechanisms; 285, Population Genetics; 287S, Quantitative Genetics; 336, Immunogenetics; 351-352, Genetics Seminar.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section Organization for Tropical Studies in the *Bulletin* in the chapter Special and Cooperative Programs.

The University Program in Marine Sciences. Interdisciplinary programs emphasizing marine botany are available. Refer to the section in this *Bulletin* entitled Marine Sciences—The University Program.

Business Administration

Professors Baligh, Cohen, Keller, Laughhunn, Lewellen, Lewin, Peterson; Associate Professors Baker, Battle, Burton, Dellinger, and Morse; Assistant Professors Aldrich, Damon, Kuhn, Magat, Maier, Taylor, Vander Weide, and Zalkind

The Graduate School of Business Administration offers work leading to the

M.B.A., Ph.D., and the M.S. in Management. The M.B.A. program is designed for students whose undergraduate work included at least one year of calculus and an educational background adequate for rigorous analysis. Normally, undergraduate majors in such fields as the physical and biological sciences, mathematics, engineering, and the social sciences are well suited for the program. The M.B.A. program is designed to provide a thorough foundation in the concepts and theory that underlie the design, operation, and control of modern complex organizations.

The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The program accepts students with bachelor's degree preparation and normally requires three to four years.

For information on the M.S. in Management, see page 87.

All 200-level courses in the Department of Management Sciences are open to graduate students from other departments. They are listed in the *Bulletin of Undergraduate Instruction.*

MASTER OF BUSINESS ADMINISTRATION

First Year Courses (Required)

300. Managerial Economics I. Fundamental theory of the firm on which analysis and planning of operations for an economic enterprise are based. Competitive price and non-price behavior in single and multiple market segments, cooperative market behavior, alternative market forms, the rationale for and form of government regulation, and production and investments examined through the use of economic theory. Emphasis on planning problems of the firm in alternative market settings and development of students' abilities to employ economic reasoning in decision-making. 5 units.

310. Mathematics for Management. Basic mathematical structures and techniques for analyzing decision problems of an enterprise. Topics include sets, relations, functions of several variables, classical optimization techniques, linear algebra, linear programming, and probability theory. Applications, cases, and problems are used to illustrate the relevance of quantitative analysis in a decision context. Conducted in parallel with the foregoing is a sub-course on computer systems. Topics include computer technology, hardware, software, use of computer systems, and the PL/I computer language. Problems from other courses in the first semester are solved using the computer. 5 units.

311. Statistical Analysis for Management Decisions. Builds upon Business Administration 310 and extends to an examination of classical and Bayesian statistics as a framework and methodology for decision-making. Included are topics such as sampling theory, estimation, hypothesis-testing, regression and correlation analysis, utility theory, and statistical decision theory. 4 units.

312. Operations Research. The development and study of quantitative models useful for structuring and solving strategy problems of the firm, and used in the third and fourth semester strategy courses. Emphasis on structuring problems in terms of quantitative models, generating solutions using both analytical and simulation approaches with and without computers, performing sensitivity analysis, implementing solutions, and developing a perspective about the role of quantitative models in management decision processes. 3 units.

320-321. Organization Theory and Management I, II. Provides the first-year M.B.A. student with an understanding of macroscopic (corporate level)

and microscopic (small group and individual level) organizational phenomena. At the macroscopic level, these courses are concerned with the study of organizations as socioeconomic-political systems in an uncontrollable environment. Topics include: (1) alternative theories of organization and (2) introduction to organization design with emphasis on goal formation, performance measurement, decomposition, administrative mechanisms for coordination and control, and organization change and adaptation. At the microscopic level, these courses examine the foundations necessary to understand the behavior and dynamics of individuals and small groups. To provide students with cooperative-competitive learning experience, small and large group projects, business games, and cases may be used. Lecture topics include: (1) individual motivation and perception, (2) small group dynamics, and (3) informal organization. Assignment of specific areas to a particular course depends on the instructor. 3 units each.

330. Accounting Systems I. Introduces the student to types of information requirements imposed on the firm by agencies in its environment and develops an understanding of the firm's activities within the framework of a financial accounting system. The system is treated as an input/output information gathering and reporting system which provides a conceptual model of the firm and reflects the impact of exchange transactions between the firm and its environment. Emphasis on the study of financial accounting reporting and measurement problems, using cases and topical problems in financial accounting. 3 units.

Second Year Courses (Required)

349. Legal Environment of the Firm. Considers the legal environment of the firm with emphasis on the legal system, the process by which laws are formulated and changed, and the type and forms of legal constraints imposed on firms. Also examined are major legislation, court cases, and regulations by federal agencies which affect the firm's decisions. 2 units.

350. Public Policy of the Firm. Builds on the theory of market failure to describe the rationale for societal intervention in business activities and reasonable firm responses. Considers environmental action, monopoly relation, discrimination, poverty, consumer issues, and problems arising from shifts in demand and supply. Emphasis on the role of the business firm in solving societal problems. 3 units.

360. Strategy of the Organization I. Problems of formulating strategy for the organization, of decomposing aggregate strategy problems into manageable subproblems, and of integrating and coordinating strategies designed for sub-problems into a consistent and implementable strategy for the organization as a whole. Specific attention to objectives of the organization in a complex environment, the objective setting process, short- and long-run strategy planning, methods for decomposing strategy planning, mechanisms for achieving integration and coordination of strategy, and the role of management information systems in strategy planning. 2 units.

361. Market Strategy. Problems associated with providing a set of products or services to consumers, and with procuring resources and services from suppliers in a manner that contributes to objectives of the organization. Specific attention to the analysis of market opportunities, product mix strategy, market segmentation, design of distribution and procurement channels, price and promotion strategy, and sales force decisions. 3 units.

362. Financial Strategy. Problems associated with the acquisition of financial resources from the external market and their effective utilization and control within the organization. Specific attention to capital markets, valuation of the firm, short-run resource planning (cash, inventory, receivables, and short- and intermediate term financing), and long-run resource planning (investment in long-lived assets, leasing, debt and equity financing, dividend policy, and the cost of capital). Institutional aspects of financial markets are emphasized only to the extent that they provide insights into problems of planning financial strategy. 3 units.

363. Operations Strategy. Problems associated with the design, operation, and control of the transformation processes utilized by an organization in producing goods and services for its external markets. Specific attention to systems design (product design, process design, capacity planning), system operation (production planning, scheduling) and system control (inventory control, quality control). 3 units.

364. Management Information and Control Systems. Problems associated with the design and operation of the information systems necessary to support strategic planning of an organization and to support the organization's control system. Specific attention to the role of information in planning and control, the economics of information, the dynamics of information flows, technologies of information systems, information system design, data base construction and maintenance and reporting systems. 3 units.

365. Strategy of the Organization II. Integrates the strategy planning and control process, organization design, and management information systems to achieve the objectives of the organization. Attention to strategy formulation, implementation, and control from the viewpoint of the organization as a whole and to the design of structures for the coordination and control of the organization. The cooperation and competitive relations of the firm with its environment are also investigated. 4 units.

Elective Courses

313. Advanced Operations Research. Deals with problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature serve as a basis for much of the class work. Students work in local industry, the University, the medical center, or in other cooperating agencies on operations research problems. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or development of new ones. 3 units.

333. Controllership. Develops systems for collecting and summarizing data in a manner which meets the requirements of the management team in controlling and planning operations. The function of the controller, as the center of synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters. 3 units.

334. External Reporting and Auditing. Builds on the information systems sequence of the first year and the public policy course, in terms of developing requirements of the system for reporting to parties external to the firm who have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the

independent auditor in developing evidence of and attesting to the reliability of data are studied in detail. 3 units.

351. Finance. Management of the financial affairs of the firm, in its attempt to develop an optimal capital structure, and includes: (1) the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and (2) the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 3 units.

353. Marketing. Applies the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involve a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 4 units.

355. Production. Provides the student with experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered, the design (or planning) of manufacturing systems and their operation (or control). Subtopics under design include plant layout, economic evaluation of materials, methods and processes, and facilities planning. Subtopics under operation include cost, inventory and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 3 units.

390. The Practicum. Gives the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of a situation and the explicit formulation of a problem. The important task of identifying and specifying the problem is an integral part of the Practicum. The Practicum report should analyze the problem and propose a solution capable of being implemented, along with the supporting explanation and logic. 4 units.

391.1-.9. Special Topics in Management. 1 to 5 units.

DOCTOR OF PHILOSOPHY

Prerequisites for the program include a one-year course in calculus, one course in linear algebra, and proficiency in a scientific computing language. The specific program of study is determined by the student and his faculty adviser, subject to the approval of the Director of the Doctoral Program. Generally, the first three semesters of study closely parallel those in the M.B.A. program. Subsequent study is devoted to developing knowledge of a research literature in each of two areas related to management. The extent of this knowledge should permit the student to begin contributing to that literature. This concentration requirement is normally satisfied in an area when a student completes two elective courses in that area beyond those courses offered in the first three semesters of the Ph.D. program. Concentrations are usually closely related to dissertation work and may be effected through courses offered on a tutorial basis.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

309.1-.9. Research in Managerial Economics. 1 to 6 units.

319.1-.9. Research in Quantitative Methods. 1 to 6 units.

329.1-.9. Research in Information and Accounting Systems. 1 to 6 units.

339.1-.9. Research in Organization Theory and Management. 1 to 6 units.

348.1-.9. Research in Public Policy and Social Responsibility. 1 to 6 units.

352.1-.9. Research in Finance. 1 to 6 units.

354.1-.9. Research in Marketing. 1 to 6 units.

356.1-.9. Research in Production. 1 to 6 units.

392-393. Tutorial in Interdisciplinary Areas. 1 to 6 units.

397. Dissertation Research. 1 to 6 units.

MASTER OF SCIENCE IN MANAGEMENT

Required Courses

300. Managerial Economics. The fundamental theory of the firm on which analysis and planning of economic activity are based. Topics include: consumer demand, perfect competition, imperfect competition, capital theory, and welfare economics. Emphasis on the application of these theories to corporate resource allocation problems. 4 units.

308. Calculus for Management. An introductory treatment of calculus for graduate students in management. 2 units.

310. Quantitative Methods. Mathematical foundations for the quantitative analysis of management problems. Topics include: optimization, linear algebra, and probability. Prerequisite: Management Sciences 308. 4 units.

311. Statistics. Statistical foundations for the quantitative analysis of management problems. Topics include: classical statistics, Bayesian statistics, and regression models. Prerequisite: Management Sciences 310. 4 units.

312. Operations Research. Deterministic and probabilistic models useful in the analysis of management problems with particular emphasis on model formulation, information requirements, model validation, sensitivity analysis, and utilization of model outputs in problem-solving. Topics include: mathematical programming, decision-making under uncertainty, and digital simulation. 4 units.

320. Organization Analysis and Design. A macroscopic study of organizations as socio-economic-political systems for collective action imbedded in an uncontrollable environment. Specific topics include: (1) alternative theories of organization with particular emphasis on modern, systems, and cybernetic approaches and (2) introduction to organization design with particular emphasis on goal formation, performance measurement, decomposition, administrative mechanisms for coordination and control, and organization change and adaptation. 4 units.

330. Accounting and Control Systems. The concept of the master budget is used to establish a basis for quantifying the planning activities of the firm and developing a financial feedback and control system for internal management and control. After a brief introduction to and review of basic data accumulation systems, topics include budgeting, standard costs and variance analysis, capital budgeting and activity analysis. 4 units.

350. External Environment of the Firm. The way in which society through the mechanism of government affects the decisions of business firms. Atten-

tion is focused on macroeconomic, legal, and social factors in the firm's environment. 4 units.

360. Planning and Control Problems of the Firm. Introduction to the functional areas of the typical firm and an integrated treatment of the strategic problems involved in economic enterprise. 8 units.

Elective Courses

340. Controllership. The need for control and ways to provide it, primarily through budgetary processes. Special attention on project evaluation, control reports, and analysis of the variance between planned results and actual results. 4 units.

341. Marketing Management. Analysis of the firm's general market competitive and cooperative strategy problem. Problem areas include pricing, product and product line design, promotion, logistics, research, the relationships among these various problem areas, and their solutions. 4 units.

342. Financial Management. Sources and uses of financial resources for the firm. Capital budgeting, cash management, and the mix of external financing in the context of attempts to achieve the optimal capital structure of the firm. 4 units.

343. Operations Management. Design of manufacturing systems, operating rules, and policies. Topics investigated are choice of technology, design of the physical system, development of operating procedures and decision rules for scheduling, inventory and cost control, quality assurance, and the interaction of manufacturing with other functions of the firm. 4 units.

349. Special Topics in Management. Examination of a specialized area in the field of management. Units to be arranged.

390. Practicum. An applied project in which the student identifies, formulates, analyzes, and proposes a solution to a practical problem. The subject will normally be a management problem from the organization in which the student works. 4 units.

Chemistry

Professor Quin, *Chairman* (101 Gross Chemical Laboratory); Professor Chesnut, *Director of Graduate Studies* (329 Gross Chemical Laboratory); Professors Bradsher, Hobbs, Jeffs, Krigbaum, McPhail, Parham, Poirier, Smith, Strobel, Wells, and Wilder; Associate Professors Henkens, Lochmüller, Palmer, and Porter; Assistant Professors Baier, Baldwin, Crumbliss, and Gutknecht; Adjunct Associate Professors Ghiradelli, Pitt, Rosenthal, and Spielvogel

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

For Seniors and Graduates

201. Molecular Spectroscopy. Selected spectroscopic methods in the study

of molecular structure. Topics include symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra, with examples drawn from both inorganic and organic chemistry. 3 units. *Staff*

203. Quantum Chemistry. Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundations of quantum theory. A major emphasis is placed on the application of molecular orbital theory to organic and inorganic systems. 3 units. *Staff*

205. Structure and Reaction Dynamics. Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Particular emphasis is placed on the use of kinetic techniques to solve problems in reaction mechanisms. 3 units. *Staff*

207. Principles of Thermodynamics, Diffraction, and Kinetics. Basic principles with applications to important chemical problems. 3 units. *Staff*

230. Chemical Pollution of Coastal Waters. Sources and sinks for chemical pollutants and impact on coastal biomes. Laboratory and field experiments to illustrate problems in verifying the extent of chemical pollution. Analysis of exemplary chemical plants to derive plans for pollution control. Prerequisites: Chemistry 161 and 162 or equivalent, Chemistry 132 or equivalent, and calculus, or permission of the instructor. (Given at Beaufort.) 6 units. *Baier*

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry, Chemistry 161, 162 or equivalent, statistics, Mathematics 183 or equivalent, or permission of the instructor. (Given at Beaufort.) Includes lectures, laboratory work, and field trips. (Also listed as Marine Sciences 240.) 6 units. *Baier*

275, 276. Advanced Studies. (1) Analytical chemistry, (2) inorganic chemistry, (3) organic chemistry, (4) physical chemistry. Open to especially well prepared undergraduates by permission of the department. 3 units each section. *Staff*

For Graduates

300. Basic Statistical Mechanics. Fundamentals of quantum and classical statistical mechanics using the ensemble approach. Emphasis on systems of weakly interacting particles with internal degrees of freedom. 3 units. *Staff*

302. Basic Quantum Mechanics. The fundamentals of quantum mechanics with special emphasis on chemical applications. Topics included are: linear algebra, the uncertainty relations, angular momentum, perturbation theory and time dependent phenomena, molecules in electromagnetic fields, group methods, and electron correlation. 3 units. *Staff*

303, 304. Special Topics in Physical Chemistry. Presentation of one or more topics of staff interest such as advanced methods in crystallography, light scattering and small angle X-ray diffraction, application of ESR spectroscopy to chemical problems, electronic spectroscopy of proteins, group theory, intermolecular forces, liquid crystals, methods of determining the rates of elementary steps in reaction kinetics, physical chemistry of aerosols, physical-chemical methods of polymer characterization, structure and bonding in metalloenzymes, statistical mechanics of fluids, topics in structural chemistry, and triplet excitons. 1 to 3 units per semester. *Staff*

310. Theoretical and Structural Inorganic Chemistry. An advanced study of theoretical concepts and structural determination techniques as applied to inorganic systems. Areas included are crystal field and ligand field theories, magnetic susceptibility, and electronic, infrared, and Raman spectroscopy. 3 units. *Crumbliss or Palmer*

312. Inorganic Reactions and Mechanisms. Chemistry of main group and transition elements. Emphasis on current developments in synthetic and mechanistic studies of inorganic, organometallic, and organometalloid compounds. 3 units. *Crumbliss or Wells*

313, 314. Special Topics in Inorganic Chemistry. Lectures, oral reports, and discussions on advanced topics and recent advances in the field of inorganic chemistry. Examples of topics which may be discussed are bioinorganic chemistry, fluxional molecules, homogeneous catalysis, synthesis and properties of selected groups of compounds, and new physical methods. 1 to 3 units per semester. *Staff*

320. Synthetic Organic Chemistry. A study of the scope and limitations of the more important types of reactions in synthetic organic chemistry. Some discussion of the rapidly developing use of transition metals, complex hydrides, and photochemistry will be included. 3 units. *Baldwin, Bradsher, or Parham*

322. Organic Reactive Intermediates. A discussion of reactive intermediates in organic chemistry. Topics will include carbanions, carbenes, carbonium ions, free radicals, photochemical excited states, and other reactive species. 3 units. *Porter or Wilder*

323, 324. Special Topics in Organic Chemistry. Advanced topics and recent developments in the field of organic chemistry. Each year heterocylic chemistry or the chemistry of natural products will be among the topics presented. Lectures, and written and oral reports. 1 to 3 units per semester. *Staff*

330. Chemical Separation Methods and Kinetics in Analytical Chemistry. The principles of rate processes and diffusion; plate-theory, adsorption and chemical selectivity. Thermodynamics of processes leading to differential migration in chromatography. Kinetic methods of analysis with emphasis on the quantitative determination of concentration in biological and non-biological systems. 3 units. *Staff*

331, 332. Special Topics in Analytical Chemistry. An advanced treatment of important areas in modern analysis. Possible topics include: electrochemistry, small computer applications, magnetic resonance, and problem-solving approaches. 1 to 3 units per semester. *Staff*

334. Chemical Instrumentation and Applied Spectroscopy. Principles of instrumental design. Topics covered include input transducers, dispersive devices, servo systems, operational amplifiers, and digital logic. An introduction to advanced topics in analytical spectroscopy. Fourier transform methods in infrared and n.m.r. spectroscopy, X-ray fluorescence, applications of lasers to high-speed measurements, and fast-scan spectrophotometry. 3 units. *Staff*

373, 374. Seminar. Required of all graduate students in chemistry. One hour a week discussion. 1 unit per semester. *All Members of the Graduate Staff*

375, 376. Research. The aim of this course is to give instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units. *All Members of the Graduate Staff*

377. Research Orientation Seminar. A survey of departmental research. Required of all entering graduate students in chemistry. Prerequisite: permission of the Director of Graduate Studies. 1 unit. *All Members of the Graduate Staff*

Classical Studies

Professor Oates, *Chairman* (325 Carr); Professor Newton, *Director of Graduate Studies* (326 Carr); Professors Richardson and Willis; Associate Professor Stanley; Assistant Professors Burian and Rigsby; Visiting Lecturer Levy

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archaeology. For regular admission to the program in literature and philology, a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archaeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information of this *Bulletin* are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of his first term in residence and the other by the end of his third term.

GREEK

For Seniors and Graduates

200. Graduate Reading. 3 units. *Stanley*

203. Homer. The *Illiad* and *Odyssey;* the problem of language and structure in the epic; present state of Homeric scholarship. 3 units. *Stanley*

205. Greek Lyric Poets. Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. 3 units. *Burian*

206. Aeschylus. The *Oresteia,* with study of the form of *Agamemnon* and its place in the design of the trilogy. 3 units. *Willis*

208. Sophocles. The Theban plays; the structure and style of Sophoclean tragedy. 3 units. *Stanley*

209. Euripides. Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. 3 units. *Stanley*

210. Aristophanes. Origin and development of Greek comedy; representative plays of Aristophanes. 3 units. *Burian*

221. Early Greek Prose. Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus, Gorgias, Antiphon, and the Old Oligarch. 3 units. *Willis*

222. Thucydides. The history; Thucydides' historical method and style. 3 units. *Willis*

223. Greek Orators I. Early fourth century rhetoric, including Andocides, Lysias, and Isocrates. 3 units. *Willis*

224. Greek Orators II. Aeschines' *Against Ctesiphon* and Demosthenes' *On the Crown* in the light of fourth century political history and rhetorical development. 3 units. *Willis*

225. Plato. Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. 3 units. *Burian*

231. Hellenistic Poetry. The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. 3 units. *Stanley*

241. Advanced Prose Composition. Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. 1 unit. *Willis*

For Graduates

(At least two of these are offered each year.)

301. Greek Seminar I. 3 units.

302. Greek Seminar II. 3 units.

303. Greek Seminar III. 3 units.

304. Greek Seminar IV. 3 units.

305. Greek Seminar V. 3 units. *Stanley*

306. Greek Seminar VI. 3 units. *Oates*

311. Proseminar in Papyrology. 3 units. *Willis*

313. Proseminar in Greek Epigraphy. 3 units. *Willis*

321. Seminar in Literary Papyri. 3 units. *Willis*

323. Seminar in Documentary Papyri. 3 units. *Oates*

399. Directed Reading and Research. Variable credit. *Stanley*

LATIN

For Seniors and Graduates

200. Graduate Reading. 3 units. *Newton*

201. The Verse Treatise. The genre of didactic poetry; emphasis on Lucretius' *De Rerum Natura*, Vergil's *Georgics*, and Ovid's *Ars Amatoria*; attention to Cicero's *Aratea*, the *Astronomica* of Manilius, Horace's *Ars Poetica*, and Ovid's *Fasti*. 3 units. *Newton*

202. Roman Satire. A survey of the genre, with concentration on Horace, Juvenal, and Persius. 3 units.

203. Epic: Vergil. The *Aeneid*. 3 units. *Newton*

204. Epic: Lucan and Statius. The development of the Roman epic in the Silver Age. 3 units. *Richardson*

207. The Prose Epistle. The letter as a vehicle of communication and as a literary form. 3 units. *Richardson*

208. The Epistle in Verse. The letter as a literary form; reading in the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. 3 units.

209. Fragments of Early Latin. The remains of Latin poetry of the third and second centuries B.C.; from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. 3 units. *Stanley*

210. Lyric and Occasional Poetry. Shorter verse forms; epigram, pastoral, song, and panegyric. 3 units.

211. Roman Oratory I. The literary history and criticism of Roman oratory. 3 units. *Richardson*

212. Roman Oratory II. A continuation of Latin 211. 3 units.

221. Mediaeval Latin I. Latin literature of late antiquity, from Prudentius to the Carolingian Revival. 3 units. *Newton*

222. Mediaeval Latin II. Literature in Latin from Charlemagne to the Renaissance. 3 units. *Newton*

225. Palaeography. Latin book hands from the Roman Empire to the Italian Renaissance. 3 units. *Newton*

241. Advanced Latin Composition. Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. 1 unit. *Richardson*

250. Teaching Latin. Objectives, methods, and problems; the study of textbooks, programs, and related materials. 3 units. *Staff*

For Graduates

(At least two of these are offered each year.)

301. Latin Seminar I. 3 units.

302. Latin Seminar II. 3 units.

303. Latin Seminar III. 3 units.

304. Latin Seminar IV. 3 units.

305. Latin Seminar V. 3 units. *Newton*

306. Latin Seminar VI. 3 units. *Newton*

312. Proseminar in Latin Palaeography. 3 units. *Newton*

314. Proseminar in Latin Epigraphy. 3 units.

315. Proseminar in Roman Law. 3 units.

399. Directed Reading and Research. Variable credit. *Newton*

CLASSICAL STUDIES

For Graduates

301. Introduction to Classical Philology. Introduction to the bibliography and principal disciplines of the field. 3 units. *Willis and Graduate Staff*

351. The Teaching of Classics. The student is introduced to the problems involved in teaching the classics. Regular classroom observation and some teaching experience. No credit. *Staff*

CLASSICAL STUDIES (ANCIENT HISTORY)

For Seniors and Graduates

253. Greece to the Orientalizing Period. 3 units. *Rigsby*

254. The Age of the Tyrants and the Persian Wars. 3 units. *Oates*

255. The Age of Pericles. 3 units. *Oates*

256. The Fourth Century through Alexander. 3 units. *Oates*

257. Social and Cultural History of the Hellenistic World from Alexander to Augustus. 3 units. *Staff*

258. Social and Cultural History of the Graeco-Roman World. 3 units.

260. The History of Rome to 146 B.C. 3 units. *Staff*

261. The Roman Revolution, 146-30 B.C. 3 units. *Oates*

262. Rome under the Julio-Claudians. 3 units.

263. From the Flavian Dynasty to the Severan. 3 units.

264. From Septimius Severus to Constantine. 3 units. *Staff*

270. The Rise of the Hellenistic Kingdoms. 3 units. *Oates*

271. The Hellenistic Kingdoms, 250-31 B.C. 3 units. *Oates*

For Graduates
(At least two of these are offered each year.)

321. Seminar in Ancient History I. 3 units.

322. Seminar in Ancient History II. 3 units.

323. Seminar in Ancient History III. 3 units.

324. Seminar in Ancient History IV. 3 units.

325. Seminar in Ancient History V. 3 units. *Oates*

326. Seminar in Ancient History VI. 3 units. *Oates*

327. Seminar in Byzantine History. 3 units. *Rigsby*

399. Directed Reading and Research. Variable credit.

CLASSICAL STUDIES (ARCHAEOLOGY)

For Seniors and Graduates

231. Greek Sculpture. Techniques and styles of the major schools and personalities in archaic, classical, and Hellenistic free-standing and architectural sculpture. 3 units. *Stanley*

232. Greek Painting. Techniques and style in the various media; emphasis on the problems of chronology, attribution, and iconography of Attic pottery. 3 units. *Stanley*

235. Roman Architecture. Significant monuments chosen to exemplify the Roman genius in building in the late Republic and early Empire. 3 units. *Richardson*

236. Roman Painting. Roman pictorial art with concentration on the wall paintings from Campania. Investigation of techniques, iconography, and the use of pictures in decoration. 3 units. *Richardson*

For Graduates
(One course is offered each year.)

311. Archaeology Seminar I. 3 units. *Stanley*

312. Archaeology Seminar II. 3 units.

Under the terms of a cooperative agreement, graduate students of Duke University may, with the approval of the chairman of their major department and upon payment of a nominal fee, take any graduate course offered by the Department of Classics of the University of North Carolina. A list of these courses will be sent upon request.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Salinger in the Department of Germanic Languages and Literature.

201, 202. Romanticism. Studies in the origin, rise, and development of the Romantic movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany with some reference to other countries. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. 3 units per semester. *Salinger*

203, 204. Realism and Symbolism. Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. 3 units per semester. *Salinger*

205. Foundations of Twentieth Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lorca, Lagerkvist, Camus, Gide, and Hesse) evolving toward a mythology of man. 3 units. *Salinger*

206. Autobiography. Origins and developments in the chief European literatures, including autobiographies of St. Augustine, Montaigne, Bunyan, Rousseau, Goethe, Carlyle, Mill, Nietzsche, Yeats, and Jung. 3 units. *Clubbe*

213. The Slavs: Literature and Culture, 1918-1939. (See course description under Slavic Languages and Literatures 213.) 3 units. *Krynski*

214. The Slavs: Literature and Culture, 1940-1970. (See course description under Slavic Languages and Literatures 214.) 3 units. *Krynski*

223. Structuralism and the New Criticism. (Also listed as Romance Languages 223.) 3 units. *Fowlie*

285. Literary Criticism. (Also listed as English 285.) 3 units. *Lievsay*

301. The Hero in European Fiction, 1830-1940. Studies in the "loss of self" from Balzac to Robert Musil. Intended primarily for minors in comparative literature. Prerequisite: permission of instructor. 3 units. *Salinger*

Computer Science

Professor Loveland, *Chairman* (407 Computation Center); Associate Professor Patrick, *Director of Graduate Studies* (408 Computation Center); Professors Gallie, Marinos, Naylor, Nolte, and Woodbury; Associate Professors Hammond and Starmer; Assistant Professors Biermann, Foster, Geller, Gerhart, and Ramm; Adjunct Associate Professor Williams

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and of at least two computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program verification, compiler design, real-time computing, operating systems, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

For Seniors and Graduates

200. Programming Methodology. Practical and theoretical topics including structured programming, specification and documentation of programs, debugging and testing strategies, choice and effective use of programming languages and systems, psychology of computer programming, proof of correctness of programs, analysis of algorithms, and properties of program schemata. Prerequisite: Computer Science 152. 3 units. *Gerhart*

201. Programming Languages. Information binding, data structures and storage, control structures, recursion, execution environments, and input/output. Syntax and semantics of languages. Study of: PL/I, Fortran, Algol, APL, LISP, SNOBOL, and SIMULA. Exercises in programming. Prerequisite: Computer Science 152. 3 units. *Gerhart or Geller*

203. Random Signals and Noise. See course description for Electrical Engineering 203. (Also listed as Electrical Engineering 203.) 3 units. *Kerr or Nolte*

205. Signal Detection and Extraction Theory. See course description for Electrical Engineering 205. (Also listed as Electrical Engineering 205.) 3 units. *Nolte*

208. Digital Computer Design. See course description for Electrical Engineering 208. (Also listed as Electrical Engineering 208.) 3 units. *Marinos or Owen*

210. Image Processing. Digital image transducers and processing algorithms, special purpose filters and tracking algorithm as applied to both binary and multi-gray level images; transducer hardware such as flying spot scanners and image dissectors. 3 units. *Starmer*

215. Artificial Intelligence. Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem-solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or permission of instructor. 3 units. *Biermann*

221. Numerical Analysis I. Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of non-linear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) 3 units. *Patrick or Gallie*

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) 3 units. *Patrick or Utku*

223. Numerical Analysis III. Rational approximation methods, spline approximations, optimization techniques, global methods for solving non-linear algebraic equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 223.) 3 units. *Patrick or Gallie*

225. Mathematical Foundations of Computer Science I. Introduction to basic concepts and techniques used in mathematical models of computation. Elements of the predicate calculus; applications to automatic theorem proving and verification of programs. Computable sets, functions, algorithmically unsolvable problems. Regular and context-free formal languages and the machines that define them. Prerequisite: four semesters of college mathematics. 3 units. *Loveland*

226. Mathematical Foundations of Computer Science II. Introduction to basic concepts and techniques used in the modeling of systems. Elements of probability, statistics, queuing theory, linear programming, linear systems, and error analysis. Prerequisite: four semesters of college mathematics. 3 units. *Foster*

231. Introduction to Operating Systems. Basic concepts and principles of multiprogrammed operating systems. Memory, CPU, I/O device management and scheduling. Buffering techniques. Performance evaluation. Case studies of existing systems. Prerequisite: Computer Science 152. 3 units. *Foster*

232. Metaprograms. Programs which process programs: compilers, interpreters, assemblers. Syntax and semantics of programming languages. 3 units. *Gallie or Geller*

241, 242. Information Organization and Retrieval. Structure, analysis, organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching procedures, indexing, file maintenance, and methods for user interaction with the automated system. Programming experience included. Prerequisite: Computer Science 152. 3 units per semester. *Hammond*

244. Computer Simulation Models of Economic Systems. (Also listed as Economics 244.) 3 units. *Naylor*

250. Clustering and Classification. Algorithms and operating characteristics of clustering and classification methods. Data models for sequential data acquisition, clustering in terms of nearest neighbor, and/or mixtures of distributions—missing information principle. Characterization of patient groups versus normal groups and selection of measures to characterize diseases as super-clusters. Application of Bayes' procedures to classification into clusters and super-clusters. Prerequisite: permission of instructor. 3 units. *Woodbury*

251. Computer Science for Teachers. An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. Summer session. 3 units. *Staff*

265. Advanced Topics in Computer Science. 3 units. *Staff*

306. Adaptive Detection and Communication Systems. See course description for Electrical Engineering 306. (Also listed as Electrical Engineering 306.) 3 units. *Nolte*

307. Advanced Digital Systems I. See course description for Electrical Engineering 307. (Also listed as Electrical Engineering 307.) 3 units. *Marinos*

308. Advanced Digital Systems II. See course description for Electrical Engineering 308. (Also listed as Electrical Engineering 308.) 3 units. *Marinos*

311. Inverse Models. See course description for Biomedical Engineering 311. (Also listed as Biomedical Engineering 311.) 3 units. *Pilkington*

315. Advanced Artificial Intelligence. Course content will vary from year to year and will include a detailed study of one or more of the following: mechanical theorem proving, natural language processing, automatic program synthesis, machine learning and inference, representations of knowledge, languages for artificial intelligence research, artificial sensorimotor systems, and others. Prerequisite: Computer Science 215. 3 units. *Biermann*

321. Topics in Numerical Mathematics. Advanced topics in numerical mathematics to be selected from areas of current research. Prerequisites: Computer Science 221 and 222 or 223. 3 units. *Patrick or Gallie*

325. Theory of Computation. Elements of recursive function theory: s-m-n theorem, recursion theorem. Abstract computational complexity: essentially complex functions, Blum speed-up theorem. Concrete complexity and analysis of algorithms, e.g., matrix multiplication. Subrecursive hierarchies: the deterministic and non-deterministic polynomial bound hierarchies. Program schemata. Techniques for proving properties of programs. Emphasis among above topics will vary from year to year. Prerequisite: Computer Science 225 or equivalent. 3 units. *Loveland*

331. Operating Systems Theory. Advanced study of analytical models of operating systems emphasizing the queuing model and its parameterization and validation. Methods for computer solutions of some models. Prerequisites: Computer Science 226 and 231. 3 units. *Foster*

332. Topics in Operating Systems. Advanced topics in operating systems to be selected from areas of current research. Prerequisite: Computer Science 331. 3 units. *Foster*

344. Workshop on Computer Models of Social Systems. See course description for Economics 344. (Also listed as Economics 344 and Political Science 344.) 3 units. *Naylor*

350. Advanced Engineering Analysis. See course description for Civil Engineering 350. (Also listed as Civil Engineering 350.) 3 units. *Utku*

Economics

Professor Kelley, *Chairman* (215-A Social Science); Associate Professor Weintraub, *Director of Graduate Studies* (315 Social Science); Professors Blackburn, Bronfenbrenner, Davies, Goodwin, Kreps, Naylor, Saville, Treml, Vernon, Wallace, and Yohe; Associate Professors Grabowski, Graham, Havrilesky, and Tower; Assistant Professors Black, Bolnick, de Marchi, McElroy, and Wyse

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are general accounting, elementary statistics, intermediate economic theory, money and banking, international trade, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. degree in economics include examination in economic theory at the end of the first year, and, at the end of the second year,

an examination in economic analysis. In addition a student must obtain certification in three fields, one of which may be in an outside minor. The student may select from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the economics department (e.g., demography). Course work for the Ph.D. degree should be completed in four semesters of residence.

For Seniors and Graduates

200. Capitalism and Socialism. Selected ideological classics of new and old right and left economics including both "counsels for perfection" (Utopias) and "precepts for action" in political economy. 3 units. *Bronfenbrenner*

204. Advanced Money and Banking. Monetary theory and its statistical and institutional implementation. Particular attention is given to the development of aggregative theories of prices, interest rates, and production; the functioning of monetary policy within various theoretical frameworks; and appraisal of the recent use and the limitations of Federal Reserve policy. 3 units. *Havrilesky or Yohe*

231. Economic Development of Europe. Sequence of local, national, and international economic structures under situations of changing trade, industry, agriculture, population, investment, war conditions, public ownership, cartels, colonialism, and prices. 3 units. *Saville.*

232. Economic History of Japan. Japanese economic development, stressing the period since the end of isolation. (Also listed as History 260.) 3 units. *Bronfenbrenner*

***233. State and Urban Finance.** Expenditures, taxation, and financial administration in state and local governments, with emphasis on current problems. Special attention will be given to research methods and materials, and to the financial relations between state and local government. 3 units. *Black or Davies*

237, 238. Statistical Methods. A study of statistical methods appropriate for dealing with problems in business and the social sciences. In addition to developing more thoroughly the subject considered in business statistics, the following methods will be considered: multiple, partial, and curvilinear correlation; curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of the instructor. 3 units per semester. *Staff*

243. Econometrics I. Economic theory, mathematics, statistical inference, and electronic computers applied to analysis of economic phenomena. Objective is to give empirical content to economic theory. Matrix algebra used to develop topics in inference, linear regression, and systems of simultaneous equations. Use is made of the electronic computer. 3 units. *Wallace*

244. Computer Simulation Models of Economic Systems. A course on the design of computer simulation experiments for economic systems. Topics include generation of stochastic variates, computer models of queuing and inventory systems, models of the firm and industry, models of the economy, simulation languages, and experimental design. (Also listed as Computer Science 244.) 3 units. *Naylor*

*Offered on demand.

245. Econometrics II. Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making simultaneous equation methods, and forecasting. Emphasis on current applied literature. A Track 1, third-level course. Prerequisite: Economics 243. 3 units. *McElroy*

262. Trade Unionism and Collective Bargaining. An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. 3 units. *Staff*

265. International Trade and Finance. A study of the fundamental principles of international trade and foreign exchange. Subjects covered will include international specialization, balance of payments, foreign investments, tariffs, and commercial policies, exchange control, exchange rates, and international monetary problems. 3 units. *Tower*

287. Public Finance. Examines the economic aspects of such problems as the growth of government, the proper role of the state, the centralization and decentralization of government, government bureaucracy, the impact of taxes and spending on the wealthy and the poor, as well as other public policies and questions. 3 units. *Davies*

293. Soviet Economic History. Establishment of foundations of a socialist economy: collectivization, industrialization, and search for economic efficiency. 3 units. *Treml*

294. Soviet Economic System. Economic planning and administration in the Soviet Union and other socialist countries. International comparisons. Theoretical and applied problems of resource allocation, economic development, and optimal microdecision-making in a nonmarket economy. 3 units. *Treml*

301. Microeconomic Analysis I. Review of contemporary theory relating to production, the firm, and income distribution in competitive and imperfectly competitive markets. 3 units. *Graham*

302. Microeconomic Analysis II. A continuation of Economics 301 with emphasis on analyses of consumer behavior, general equilibrium, welfare economics, and capital theory. Prerequisite: Economics 301. 3 units. *McElroy or Weintraub*

303. Theory of Economic Decision-Making. The extension of economic theory to the allocation of resources within firms and governmental units. Prerequisite: Economics 301 or its equivalent. 3 units. *Staff*

304, 305. Monetary Theory and Policy. In the first semester: theories of the supply of and demand for money (neoclassical and Keynesian macroeconomic), general equilibrium theories, and theories of the term structure of interest rates. In the second semester: the theory and practice of the monetary policy with emphasis on recent issues, the monetarist-fiscalist controversy, the monetary policy transmission mechanism, and policy simulations with econometric models. 3 units per semester. *Havrilesky or Yohe*

307. Quantitative Analysis I. A systematic analysis of the principal quantitative methods used in microeconomic theory. Neoclassical theories of production and distribution are used as vehicles for presenting the material. Considerable emphasis is placed on the application of mathematical analysis to economic models. 3 units. *McElroy*

308. Quantitative Analysis II. Linear economic models, particularly Leontief models, are used in the exposition. Primary emphasis is placed on the application of mathematics to economic theory. Prerequisite: Economics 307 or consent of instructor. 3 units. *Graham*

311, 312. History of Political Economy. A detailed review of the development of economic theory, the tools of economic analysis, and economics as a science, together with an analysis of the circumstances affecting this development. Period covered: pre-Christian times through 1936. 3 units per semester. *Goodwin*

313, 314. Seminar in Economic Theory. Prerequisite: Economics 301 or its equivalent. 3 units per semester. *Weintraub*

316. Seminar in Economics of Soviet-Type Socialism. Selected topics in analysis of theoretical and institutional framework of Soviet economic system, such as markets versus plan, optimizing techniques in planning, price determination, balanced economic development, and ideology and economic policy. 3 units. *Treml*

317. Seminar in Demographic, Population, and Resource Problems. 3 units. *Kelley*

318. Dissertation Seminar. 3 units. *Staff*

319. Seminar in the Theory and the Problems of Economic Growth and Change. 3 units. *Staff*

320. Macroeconomic Analysis I. Measurement of national income and other important aggregates; classical macroeconomics; Keynesian and more recent views of the determinants of income, employment, and price levels; empirical studies of consumption, investment, and monetary variables. 3 units. *Bronfenbrenner*

321. Theory of Quantitative Economic Policy. The use of mathematical models in analyzing the connections between means and ends of economic policy; topics covered include principles and design, centralization and decentralization, stabilization and growth policies, welfare optimization, imperfect models, and the use of control system analysis. Prerequisite: Economics 320. 3 units. *Staff*

322. Macroeconomic Analysis II. Further analysis of topics treated in Economics 320. Optimal economic growth; business cycles. Issues in economic policy. Prerequisite: Economics 320. 3 units. *Graham and Weintraub*

323. Income Distribution Theory. Income distributions—functional and personal. Concepts and measures of poverty and inequality. Maldistribution issues—ethical and economic. Pricing of productive services, primary attention on wages and employment. Rival aggregative (macro distribution) theories. Prerequisites: intermediate micro- and macro-economics and some knowledge of calculus and statistics. *Bronfenbrenner*

329. Federal Finance. An analysis of the trends and hypotheses concerning the growth in governmental activity, the optimum level and composition of governmental spending, and the microeconomic and macroeconomic effects of governmental spending and tax policies. 3 units. *Davies*

330. Seminar in Public Finance. 3 units. *Wyse*

331. Seminar in Economic History. 3 units. *Staff*

344. Workshop on Computer Models of Social Systems. A course on the methodology of constructing computer simulation models of social systems including political, economic, social, administrative, and educational. Although the emphasis of the course is on a variety of different types of models of social systems, special consideration is given to the methodology of designing simulation experiments. (Also listed as Computer Science 344 and Political Science 344.) 3 units. *Naylor*

345, 346. Demographic Techniques I and II. (Also listed as Sociology 345, 346.) 3 units each semester. *Myers*

350. Seminar in Applied Economics. A course that will use the principles of micro-economics in the analysis of problems and policies. The particular contextual materials that will be subjected to analysis will vary from time to time. Materials will be treated in the tradition of positive economics.

355. Seminar in Labor Economics. 3 units.

358. Seminar in Labor Market and Related Analysis. 3 units. *Staff*

365. Seminar in International Economics. 3 units. *Tower*

366. Monetary Aspects of International Trade and Finance. The monetary, as opposed to the pure, side of international economics. Among the topics considered are the balance of payments, the foreign-exchange market capital movements, payments equilibrium, the demand for reserves, and international monetary reform. 3 units. *Tower*

***388. Industrial Organization.** The theory, measurement, and history of the firm-structure of industry. Emphasis upon the structure of American industry and upon actual production and pricing practices. Criteria for evaluating industrial performance. 3 units. *Vernon or Grabowski*

***389. Seminar in Industrial and Governmental Problems.** 3 units. *Vernon*

397, 398. Directed Research.

401. Seminar on the British Commonwealth. 3 units. *Ball, Preston, and Others of the Committee on Commonwealth Studies*

402. Interdisciplinary Seminar in the History of the Social Sciences. 3 units. *Goodwin, Holley, and Spragens*

Related Courses in Other Departments

Courses in related fields may be selected from anthropology, computer science, forestry, history, mathematics, philosophy, political science, and sociology, or from an area that complements the candidate's area of research interests in economics.

See Program in Comparative Studies on Southern Asia and the Center for Demographic Studies in the chapter on Special and Cooperative Programs for further information.

Education

Professor Flowers, *Chairman* (213 West Duke Building); Professor Petty, *Director of Graduate Studies* (205 West Duke Building and 116 Allen Building); Professors Adams, Cartwright, S. Gehman, Githens, Hopkins, Hurlburt, Shuman, Tuthill, and Weitz; Associate Professors Ballantyne, Carbone, Colver, L.

*Offered on demand.

Davis, Di Bona, Johnson, Katzenmeyer, Martin, and Pittillo; Adjunct Professor J. Davis; Part-time Instructor Swain; Lecturers Fowler, I. Gehman, and Leach

Graduate work in education is offered leading to the A.M., the M.Ed., the M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in this *Bulletin*. Departmental requirements and prerequisites for all of these degrees may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the Advanced Principal's Certificate, the Superintendent's Certificate, and the Supervisor's Certificate.

(Some courses below are offered only in the summer session; see the *Bulletin of the Summer Session.*)

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel with the doctor's degree as the highest degree approved.

For Seniors and Graduates

201. Teaching and Supervision of Arithmetic. Special attention is given to the number system, the fundamental operations (with whole numbers, fractions, and decimals), percentage, and measurements. Considered also are the meaning theory, methods of teaching, problem-solving, evaluation, practice and drill, and selection and gradation of arithmetical contents. Designed for teachers and supervisors in elementary schools. 3 units. *Petty*

202. Comparative and International Education: Industrialized Nations. Structure and functioning of educational institutions in selected developed societies. Emphasis on relevant social science theory and methods. 3 units. *Di Bona*

204. Educational Organization. Explores theory and research on the processes of exchange between educational organizations and their external environments, and the influence of these processes on organizational structure, goals, and practices. Schools, colleges, and universities are considered as separate types of educational organizations, and a comparative approach is emphasized in examining these as well as other forms of social organizations, e.g., hospitals, businesses, and prisons. 3 units. *Martin*

206. Studies in the History of Educational Philosophy. The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. 3 units. *Carbone*

207. Social History of Twentieth Century American Education. Twentieth century American education in the context of social and intellectual history. 3 units. *Johnson*

209. John Dewey. Dewey's major writings with emphasis on his philosophy of education. 3 units. *Carbone*

210. The Politics of Education. See course description for Political Science 210. (Also listed as Political Science 210.) 3 units. *Leach*

***213. Elementary School Organization and Administration.** This course is designed especially for principals, teachers, and other prospective members of

*Offered on demand.

the elementary school staff. The scope of elementary education is considered to encompass nursery school, kindergarten, and the elementary school. Special treatment is given to the problems of internal organization and management of the elementary school, and its integration with the secondary school level. 3 units.

215. Secondary Education: Principles. Principles, curriculum, and methods in secondary education. Prerequisite: C average overall and in teaching field or fields. Must be accompanied by Education 216. 3 units. *Cartwright, Githens, or Shuman*

216. Secondary Education: Internship. Supervised internship in junior or senior high schools. Full-time observation and teaching for half a semester, accompanied by Education 215; or, with permission of the department, full-time teaching for a semester, accompanied by Education 315. Students carrying Education 216 for credit toward a master's degree will be required to take six hours of senior or graduate work in addition to the normal degree requirements. 6 units. *Cartwright, Githens, Hurlburt, or Shuman*

217. The Psychological Principles of Education. An advanced study of teaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. 3 units. *Davis, Gehman, or Weitz*

218. Comparative and International Education: Developing Societies. Structures and functioning of educational institutions and processes in developing nations. 3 units. *Di Bona*

219. Comparative and International Education: South Asia. Traditional and modern educational developments in India and Pakistan. 3 units. *Di Bona*

221. Programs in Early Childhood Education. Examination of the objectives and philosophy underlying programs in early childhood education, including an overview of existing practices, research findings, and experimental projects dealing with social, emotional, physical, and cognitive development. 3 units. *Flowers*

222. New Developments in Elementary School Curriculum. The open classroom, team teaching, non-graded programs, and individualized instruction. Assessment of recent emphasis on early childhood education and the middle school. 3 units.

223. Teaching the Language Arts. Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. Increasing opportunities for creative expression. Correlation of language arts with other activities and school subjects. 3 units. *Adams*

224. Teaching the Social Studies in Elementary Schools. 3 units.

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. 3 units. *Cartwright*

226. Teaching Developmental and Remedial Reading in the Elementary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. 3 units. *Adams*

227. The Teaching of Geography. 3 units.

*Offered on demand.

229. Formal and Informal Classroom Diagnosis of Reading Disability Cases. Designed to acquaint teachers, supervisors, and administrators with various standardized tests, other instruments, and informal procedures utilized in diagnosing reading problems of elementary and secondary pupils. 3 units. *Adams*

233. Improvement of Instruction in English. Recent developments and research techniques in the teaching of English with individual projects. Prerequisite: permission of instructor. 3 units. *Shuman*

234. Secondary School Organization and Administration. This course is designed especially for principals, teachers, and other prospective members of the secondary school staff. The scope of secondary education is considered to encompass junior high school, regular high school, senior high, and junior college. Special treatment is given to the problems of internal organization and management. 3 units. *Flowers*

236. Teaching Developmental and Remedial Reading in the Secondary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. For secondary school teachers of all subjects who wish to improve the reading and study habits of their students. 3 units. *Adams*

237. The Teaching of Literature in Secondary Schools. Literature generally taught in secondary schools. Adult and transitional literature are considered. Methods of organizing the program and of teaching literature. 3 units. *Shuman*

238. Content, Supervision, and Administration of Reading Programs. The nature and functions of the objectives of various reading programs, organization of such programs, their major attributes, and their evaluation. For supervisors, teachers, and administrators. 3 units. *Adams*

239. The Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School. Recent development in the teaching of grammar, composition, mechanics, and usage. Students will write and grade compositions. Term project. 3 units. *Shuman*

240. Career Development. An analysis of the world of work; socio-personal factors affecting occupational choice; theories of career development; and use of occupational and educational resources. 3 units. *Ballantyne or Colver*

241. Foundations of Counseling and Personnel Services. Scope, principles, historical background, services, trends, and issues of counseling and pupil personnel services. 3 units. *Ballantyne or Colver*

243. Personality Dynamics. A study of personality structure and dynamics with emphasis upon the implications for counseling and instruction. Prerequisite: six hours of psychology or educational psychology. 3 units. *S. Gehman*

244. Counseling Techniques. A study of individual counseling techniques including diagnosis, interviewing, program planning, and counseling evaluation. Prerequisites: Education 243 and 258 or equivalent, which may be taken concurrently. 3 units. *S. Gehman*

245. Theories of Counseling. A study of the major theories of counseling. 3 units. *Weitz*

246. The Teaching of Mathematics. This course deals with such topics as

aims, curriculum, course and lesson planning, and classroom procedure for teaching secondary school mathematics. 3 units.

247. Practicum in Guidance and Counseling. Intensive field experience in local settings, designed to provide the student with opportunities to participate in on-going counseling and guidance program. A minimum of 150 hours of case work and supervision required. Prerequisites: Education 244 and permission of instructor. 3 units per semester. May be repeated. *Ballantyne, Colver, Gehman, or Weitz*

248. Practicum in Counseling. Practice in individual counseling, including test administration, intake interviewing, diagnosis, program planning, report preparation and evaluation. The student will be expected to devote approximately 150 hours to case work and conferences with his supervisor. Prerequisite: permission of instructor. 3 units per semester. May be repeated. *Ballantyne, Gehman, or Weitz*

249. Exceptional Children. A survey of the major categories of exceptional children, mental retardation, emotional disturbance, brain injured, learning disabilities, physically handicapped, visual and auditory deficits, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment will be discussed. 3 units. *Davis*

250, 251. Teaching Emotionally Disturbed Children: Internship. Basic principles and practices in teaching and the organization of instructional materials. Work with children under the supervision of a certified teacher of emotionally disturbed children. Experience in general classroom teaching and small group and individualized instruction. Participation in staff conferences involving psychiatrists, psychologists, social case workers, and professional educators. 3 units per semester. *S. Gehman*

253. Introduction to Law and Education. Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. 3 units. *Martin*

254. Law and Higher Education. Concepts and procedures relating to higher education. Emphasis upon court decisions. Prerequisite: Education 253 or permission of instructor. 3 units. *Flowers*

255. Assessment of Abilities. The selection, use, and interpretation of various instruments for predicting and evaluating the outcome of educational experiences, including surveys of standardized tests of aptitude and achievement. 3 units. *Colver*

256. Classroom Assessment of Student Achievement. The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. 3 units. *Colver*

258. Assessment of Personality, Interests, and Attitudes. The rationale, construction, use, and interpretation of standardized instruments designed for the assessment of student's interests, attitudes, and personality. Emphasis on counseling applications. Prerequisites: Education 243 and 255 or approval of instructor. 3 units. *Colver or Weitz*

259. Problems in Law and Education. Concentration on current issues and to researching of cases, constitutional decisions, and statutes. Prerequisite: Education 253 or by permission of instructor. 3 units. *Martin, Pittillo, or Flowers*

260. Introduction to Educational Research. Research methodologies: experimental, historical, survey, philosophic, and case study. Fundamentals of

statistical inference, research design, and computer applications to research problems. 3 units. *Katzenmeyer*

261. Intermediate Educational Research. Intermediate topics in statistical inference. Analysis of covariance and multiple regression. Computer applications in research. Research design. Prerequisite: Education 260 or its equivalent. 3 units. *Katzenmeyer*

266. Basic Science for Teachers. Presentation of basic concepts in natural and physical science through selected readings, the use of simple experiments and demonstrations, construction and use of equipment, and field studies. 3 units. *Githens*

268. Seminar in Contemporary Educational Criticism. Critical analysis and discussion of the writings of contemporary critics of education. 3 units. *Carbone, Di Bona, Johnson, or Martin*

270. The Junior/Community College. A study of the history, philosophy, and roles of junior and community colleges in the United States, with emphasis on recent developments, current problems, and issues. An introductory course for students preparing to be teachers, counselors, or administrators in a two-year college. 3 units per semester. *Hopkins or Hurlburt*

271. Teaching in the Junior/Community College. A study of alternative instructional approaches and systems for junior/community colleges, with special attention to the systems approach and the individualization of instruction for a heterogeneous student population. 3 units per semester. *Hopkins*

272. Teaching Communication Skills in Early Childhood Education. An examination of the development of communication skills from birth to age eight with emphasis on reading readiness and language growth. 3 units. *Adams*

273, 274. Clinical Reading Practicum. Clinical experiences in the diagnosis and correction of reading disabilities in elementary and secondary students. Prerequisite: permission of instructor. 3 units per semester. *Adams*

276. The Teaching of High School Science. Discussion, lectures, and collateral reading, related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary school science. 3 units. *Githens*

285. Audiovisual Aids in Education. The aims and psychological bases of audiovisual materials in the classroom. Attention to such materials as charts, filmstrips, flat pictures, maps, models, motion pictures, radio, records, slides, and television. Offered in summer only. 3 units.

291. Public and Community Relations of School. 3 units.

For Graduates

300. Individual Assessment of Intelligence. Individual intelligence as measured by standardized individual instruments, chiefly the Wechsler Intelligence Test for Children and the Stanford-Binet L-M. Theory, administration, scoring, analysis, interpretation, and reporting. Work with children in supervised school settings. Prerequisite: permission of instructor. 3 units. *Davis*

301. Advanced Individual Assessment of Cognitive Abilities. Development of advanced understanding and skills in the use of clinical instruments for assessment of cognitive abilities. Analysis, interpretation, and consultation about individual assessment. Supervised experience involving collaboration

with children, school personnel, parents, and clinic and community representatives. Prerequisites: Education 300, or equivalent, and permission of instructor. 3 units. *Davis or Gehman*

302. Seminar in Educational Research. The seminar is primarily for students working on dissertations and theses. Students submit research proposals, plan a research project, and make periodic progress reports. Special topics are considered as appropriate to the research designs developed. Prerequisite: Education 260 or 261. 3 units. *Katzenmeyer*

303. Diagnostic and Educational Programs in Learning Disabilities. Diagnostic, intervention, and remediation strategies and program development for the child with learning disabilities; review of major works in this field. Prerequisite: permission of instructor. 3 units. *Davis or S. Gehman*

304. Internship in School Psychology. Supervised internship in school psychology, utilizing principles and practices in an approved internship site. May be repeated. By permission of instructor. 3 units. *Davis*

306. Seminar in Philosophical Analysis of Educational Concepts. Selected writings of contemporary philosophers, with special emphasis on such educational concepts as teaching, learning, knowing, understanding, indoctrination, explanation, and education. 3 units. *Carbone*

309. Seminar on Higher Education in the United States. A study of the major trends, issues, problems, new developments, and future prospects for higher educational institutions (excluding the junior/community college) in the United States. 3 units per semester. *Flowers or Hopkins*

310. Seminar in Higher Educational Administration. New developments in the organization and administration of higher educational institutions, with special attention to administrative and organizational systems, management information systems, managerial accountability, and strategies for continuous planning and institutional renewal. 3 units per semester. *Hopkins*

311. Group Counseling. A study of theories and techniques of counseling for small groups of children, adolescents, teachers, parents, and other adults. Simulated practice through recorded interviews and transcribed counseling sessions. Prerequisites: Education 244 and Education 245. 3 units. *Gehman*

313. Seminar in Education and Public Policy. The relationship of educational administration to the public policy process. (Also listed as Political Science 313.) 3 units. *Leach or Pittillo*

314. Seminar in Guidance and Counseling. Research, writing, and reporting on selected problems in the field of guidance and counseling. 3 units. *Weitz*

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 units. *Carbone or Hurlburt*

316, 317. Practicum in Higher Educational Research and Development. Review of the purposes and essential stages of research and development in higher education, followed by individual projects covering problem-identification, literature searches related to the problem, development of product specifications and design, and pilot testing of prototype product. Enrollment limited to five students. 3 units each. *Hopkins*

321. Educational Management. A study of theory and practice of management as applied to education. This course is intended for anyone who has or is preparing to have major management responsibilities in the field of education. 3 units. *Pittillo*

322. Planning and Management of Educational Facilities. A study of planning and management of educational facilities and equipment. This course is intended for teachers, administrators, and supervisors. 3 units. *Pittillo*

*__323. Public School Finance.__ A study of educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. 3 units. *Pittillo*

326. Educational Psychology: The Problem Child. Study of problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. 3 units. *I. Gehman*

332. Supervision of Instruction. A study of the nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 units. *Hurlburt*

335, 336. Seminar in School Administration. Organization and control over public education. First semester: attention to governance of education as exercised by the different branches and levels of government. Second semester: administrative organization. 3 units per semester. *Flowers, Hurlburt, Petty, or Pittillo*

337. Seminar in Community College Organization. Discussion of the nature, function, and organization of community colleges. Research, writing, and reporting on selected problems. 3 units. *Hurlburt*

338. Seminar in Educational Supervision. Open to students who have completed Education 332 or its equivalent. 3 units. *Hurlburt*

339. Seminar in Curriculum. Research, writing, and reporting on selected problems. 3 units. *Cartwright*

340. Seminar in Social Studies Curriculum. Research, writing, and reporting on selected problems. 3 units. *Cartwright*

341. Seminar in Elementary School Curriculum. Research, writing, and reporting on selected problems. 3 units.

342. Seminar in Secondary School Curriculum. Research, writing, and reporting on selected problems. 3 units. *Cartwright*

343. History of Higher Education in America. A history of the growth and development of higher education in the United States from 1636 to the present. The early role of religious groups in establishing colleges, the continuing role of private higher education, and the evolutionary development of public higher education, including state and land-grant universities, teachers colleges, state colleges, and community colleges, are stressed. 3 units.

344. Research in Higher Education. Review of theory, practice, and contribution of research as an aid in understanding the functioning of institutions of higher education. Emphasis on empirical studies utilizing the approach and methods of social science. Also specific concern with historical, economic, and

*Offered on demand.

philosophical approaches. Will consider new or emerging frontiers of study such as channels of access to higher education, assessment of the learning environment, attitudinal changes in college students, and contributions of the college to societal needs. 3 units.

345. Seminar in Reading Instruction and Research. A study of the major problem areas in contemporary reading teaching, with emphasis on theoretical, historical, and philosophical contributions to the formulation of objectives and methodologies in modern reading instruction. 3 units. *Adams*

346. Seminar in Organization of Pre-Service and In-Service Reading Programs. Student development of various content and instructional strategies for possible implementation in university undergraduate reading and language arts courses and in public school in-service programs. For graduate students interested in teaching reading and language arts courses at the university level or in coordinating and directing in-service education programs in reading. 3 units. *Adams*

347. Student Personnel Services in Higher Education. A study of the basic objectives of student personnel services in post-secondary education and the administrative procedures developed to achieve these objectives. Attention will be directed to many of the specific personnel services. 3 units. *Colver*

348, 349. Seminar in Child Psychopathology. Under the direction of a child psychiatrist, the student will select one elementary school age child for a psychoanalytic study of neurotic conflicts, unconscious motivations, dream work, defense mechanisms, and transference phenomena. Prerequisite: permission of instructor. 3 units per semester. *Fowler*

350, 351. Directed Activities in Education. Selected internship experiences at an advanced level under supervision of appropriate staff. Prerequisite: approval of instructor. 3 units per semester. *Staff*

360. Seminar on Instructional Strategies. This seminar provides an opportunity to examine the strategies espoused for effective instruction by a variety of writers, to examine the relationships among broad purposes of education, the process and product objectives, and the strategies employed to achieve those purposes and objectives. A synthesis among the purposes, objectives, and strategies is sought. 3 units. *Katzenmeyer*

Engineering

Aleksandar Sedmak Vesić, D.Sc., *Dean* (136 Engineering)

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designed to provide a fundamental understanding of the engineering sciences, which are based on mathematics and the physical sciences, and to develop experience in the art of engineering, which includes strong elements of intuition, imagination, and judgment. Each engineering graduate student may participate in seminars appropriate to his field of study.

A *minimum* of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A non-thesis option requiring 30 units of course credit is

available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A *minimum* of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering, 24 in the major, 12 in related minor work (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and the Dean of the School of Engineering, and 12 for a research-based dissertation. In mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman;* Professor Thurstone, *Director of Graduate Studies;* Professors Bennett, McElhaney, Nolte, and Wolbarsht; Associate Professors Barr, Clark, Hammond, and Wachtel; Assistant Professors Evans and von Ramm

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics; biomedical materials; biomedical modeling; data acquisition and processing; and electrophysiology.

201. Analysis of Bioelectric Phenomena. Fundamentals of bioelectric modeling with emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole-organism level. Not open to students who have had B.M.E. 181. 4 units. *Wachtel*

202. Energy and Rate in Biomedical Processes. An introduction to biomedical thermodynamics and transfer processes with particular emphasis on environmental studies, hyperbaric exposure, and the functions of natural and artificial organs. Not open to students who have had B.M.E. 172. 3 units. *Clark or Bennett*

203. Bioelectric Potentials and Field Theory. A study of bioelectric potentials and models for their generation. Analysis from a field theoretic point of view with particular emphasis on formulations that are amenable to computation. 3 units. *Barr or Pilkington*

204. Real Time Measurement and Control of Heart Events. Specification of procedures and devices from biological considerations, and their design and construction. Consideration of amplifiers, analog-digital conversion, computer interfaces, and associated programming. Evaluation of selected examples for accuracy, complexity, and cost. 3 units. *Barr*

223. Biomedical Materials and Artificial Organs. The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. 3 units. *Clark*

225. Mechanics of Cellular Components. Concepts of solid, semi-solid, and liquid mechanics applied to the study of cell components, e.g., membranes, cytoplasm, organelles, nuclei, etc. Transition from molecular structure to continuum properties will be emphasized. Prerequisite: permission of instructor. 3 units. *Evans*

230. Biomechanics. Kinematic models of human motions, mechanical properties of bone and soft tissues, hydrodynamics of micturition, load directed growth mechanisms, human tolerance to impact and vibration, head injury criteria applied to helmet design. Prerequisite: permission of instructor. 3 units. *McElhaney*

233. Discrete Systems and Models of Computation. Difference equations, numerical approximation, and digital filters with particular emphasis on developing constrained models that are both physically reasonable and amenable to computation. 3 units. *Pilkington*

241, 242. Information Organization and Retrieval. Structure, analysis, organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching procedures, indexing, file maintenance, and methods for user interaction with the automated system. Programming experience included. Prerequisite: Computer Science 152. (Also listed as Computer Science 241, 242.) 3 units per semester. *Hammond*

265. Advanced Topics in Biomedical Engineering. Advanced subjects related to programs within biomedical engineering, tailored to fit the requirements of a small group. Prerequisite: approval of the chairman and the instructor under whom work will be done. 1 to 4 units. *Staff*

311. Inverse Models. Analytical and computational methods for determining the internal state of a biological system from a set of external measurements and *a priori* characterization of the system. Particular emphasis is placed on the inherent limitations and difficulties encountered in obtaining numerical solutions from inverse formulations and the value of constraints in reducing these difficulties. (Also listed as Computer Science 311.) 3 units. *Pilkington*

333. Biomedical Imaging. A study of the fundamentals of information detection, processing, and presentation associated with imaging in biology and medicine. Analysis of coherent and incoherent radiation and various image generation techniques. Also covered will be the psychometrics of image evaluation dealing with subjective and objective parameters. Emphasis will be placed upon sonography, thermography, X-ray, various forms of nuclear radiography, microscopy, and holography. 3 units. *Thurstone*

399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units per semester. *Graduate Staff*

CIVIL ENGINEERING

Professor Muga, *Chairman* (121 Engineering); Professor Dvorak, *Director of Graduate Studies* (126 Engineering); Professors Brown, Utku, and Vesić; Associate Professors Palmer, Vesilind, and J. F. Wilson; Assistant Professors Dajani and Warner; Adjunct Assistant Professor Drye; Lecturers Behn and Rimer

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in civil engineering and the A.M. degree in public policy sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If the candidate elects this alternative, he is expected to take a comprehensive examination over his graduate course work, and also to defend orally his special project.

Under the Reciprocal Agreement with Neighboring Universities, a student may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

201. Advanced Mechanics of Solids. Cartesian tensors, dyadics, and matrices. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. Corequisite: Mathematics 285 or equivalent. 3 units. *Dvorak*

204. Plates and Shells. Differential equations and extremum formulations of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian plates of isotropic and orthotropic materials. Solution methods. Differential equation formulation of thin shell problems in curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution, and plates. Extremum formulation of shell problems. Solution methods. Prerequisite: consent of instructor. 3 units. *Utku*

205. Elasticity. Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: C.E. 201 or equivalent. 3 units. *Dvorak*

210. Intermediate Dynamics. (Also listed as Mechanical Engineering 210.) 3 units. *J. F. Wilson or Macduff*

212. Mechanical Behavior of Materials. Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: C.E. 201. 3 units. *Dvorak*

215. Urban and Regional Geography. Human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive location decisions. Location and impact of constructed facilities. Spatial interaction and network structure. Geography of transportation and environmental quality. 3 units. *Dajani*

216. Transportation Planning and Policy Analysis. Issues in policy planning and decision-making in urban and rural transportation systems. Transportation legislation. Public transportation alternatives with emphasis on mass transit and paratransit solutions. Prerequisite or corequisite: C.E. 116 or consent of instructor. (Also listed as Public Policy Sciences 254.) 3 units. *Dajani*

217. Transportation Systems Analysis. The transportation systems planning process. Quantitative analysis, mathematical modeling, and computer simulation techniques for short and long-range planning and evaluation of transportation systems. Prerequisite or corequisite: C.E. 116 or consent of instructor. 3 units. *Dajani*

218. Engineering-Economic Analysis. Methods of analysis applicable to the economic evaluation of both pre-construction project plans and post-construction project outcomes. Principles of engineering economics with regard to time dependent costs and benefits. Techniques of economic evaluation, comparisons of multiple alternatives, and introductory systems analysis. Concepts of welfare economics with regard to public works development. Identification and measurement of both monetary and non-monetary consequences of public works. Ex-post evaluation of public works projects. 3 units. *Warner or Dajani*

221. Incompressible Fluid Flow. Steady and unsteady pipe flow, theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluids systems; effect of resistance; tapered conductors. 3 units. *Muga*

222. Open-Channel Flow. Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, and flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. 3 units. *Muga*

223. Flow Through Porous Media. Theory of miscible and immiscible fluid displacement processes. Derivations and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, and well point operation. 3 units. *Muga*

224. Coastal and Offshore Engineering. Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, wave spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. 3 units. *Muga*

225. Engineering Hydrology. Study of processes governing the origin, distribution, depletion, and replenishment of water resources and application of this knowledge to the solution of water supply and drainage problems. Topics include the hydrologic cycle, hydrometeorolgy, precipitation runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. 3 units. *Warner*

231. Structural Engineering Analysis. The analysis of fundamental structural forms including arches, suspension cables and members of variable inertia. Influence lines for indeterminate structures. Introduction to matrix analysis. Prerequisites: C.E. 131 and Math. 104 or consent of the instructor. 3 units. *Brown*

232. Reinforced Concrete Design. A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, shear, and diagonal tension. Two-way slabs and flat plates design. Prerequisite: C.E. 133. 3 units. *Brown*

233. Prestressed Concrete Design. A critical review of research and recent development in prestressed concrete design. Prestressed tanks, beams, and columns, partially prestressing and composite design. Prerequisite: C.E. 133. 3 units. *Brown*

234. Structural Design in Metals. Design of metal structures using both elastic and plastic theories. Application to place girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: C.E. 134. 3 units. *Palmer*

235. Foundation Engineering. An introduction to methods of analysis, design and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; underpinning. Foundation vibrations. 3 units. *Vesić*

236. Earth Structures. An introduction to methods of analysis, design, and construction of earth structures, such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells, and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. 3 units. *Vesić*

238. Rock Mechanics. Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock-testing techniques. Prerequisite: C.E. 139 or consent of instructor. 3 units. *Staff*

241. Environmental Engineering Chemistry and Biology. Inorganic and organic chemistry as applied to water and waste-water treatment. Chemical equilibria and kinetics. Population dynamics and energy transfer in metabolic systems. Instrumental analysis, including spectrophotometry, chromatography, atomic adsorption. Atmospheric chemistry and analytical methods. Prerequisite: C.E. 124. 3 units. *Drye*

243, 244. Sanitary Engineering Unit Operations and Process Design. Fundamental bases for design of water and waste treatment systems, includ-

ing transport, mixing, sedimentation and filtration, gas, transfer, coagulation, and biotreatment processes. Prerequisite: C.E. 124 or consent of instructor. 3 units per semester. *Vesilind*

246. Sanitary Engineering Design. The study of water resources and municipal water requirements including reservoirs and transmission, treatment, and distribution systems; methods of collection, treatment and disposal of municipal and industrial waste-waters. The course includes the preparation of a comprehensive engineering report encompassing all aspects of municipal water and waste-water systems. Field trips to be arranged. Prerequisite: C.E. 124 or consent of instructor. 3 units. *Rimer or Vesilind*

247. Air Pollution Control. The problem of air pollution with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor, and air pollution law. 3 units. *Vesilind*

248. Solid Waste Management. Collection, treatment, and disposal of solid wastes from waste-water treatment. Filtration and centrifugation theory and application. Pumping of solid-liquid mixtures. Sludge conditioning by chemicals and heat. Sludge combustion, pyrolysis, and drying. Application of systems analysis to collection of municipal refuse. Sanitary landfills and incineration of solid wastes. Reuse and recycling. Prerequisite: C.E. 124 or consent of instructor. 3 units. *Vesilind*

250. Engineering Analysis. Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem solving techniques. 3 units. *J. F. Wilson*

251. Systematic Structural Analysis I. Computer analysis techniques for the equilibrium problems of solids and structures. Describing the problems to a digital computer. Transformation matrices. Recapitulation of energy theorems. Stiffness and flexibility relations of structural elements in discrete space and continuum. Systematic analysis of equilibrium problems by displacement and force methods. Errors. Prerequisites: Math. 104, C.E. 131 or Engineering 135 or equivalent. 3 units. *Utku*

252. Systematic Structural Analysis II. Computer analysis techniques for the equilibrium, eigenvalue, and propagation problems of solids and structures. Representation of initial stresses. Handling of geometrical nonlinearities in equilibrium problems. Buckling. Handling of material nonlinearities. Incremental load techniques. Time dependent materials. Representation of inertial and damping forces. Stationary and transient vibrations. Random vibrations. Prerequisite: C.E. 251 or consent of instructor. 3 units. *Utku*

306. Plasticity. Mathematical theories of time-dependent inelastic material behavior and their experimental foundations. Yield conditions, flow and hardening rules, unloading, shakedown. Theories of limit analysis. Slipline fields. Numerical methods. Applications to problems in the design of structures, metal forming, stress analysis in metals and composites, and in fracture mechanics. Prerequisite: C.E. 205. 3 units. *Dvorak*

*__309. Advanced Dynamics.__ Motion and stability (small and global) of discrete and continuous structural systems; Liapounov's theorems; parametric and random excitation. (Also listed as M.E. 309.) Prerequisite: C.E. or M.E. 210, or permission of instructor. 3 units. *J. F. Wilson*

*Offered on demand.

331. Special Problems of Systematic Analysis. Roundoff and truncation errors. Bounds for approximate solutions. Higher order representations and their advantage and disadvantages. Connectivity matrices and systematic substructuring. Improved algorithms for linear equation solution and eigenvalue extraction. Prerequisite: C.E. 252 or consent of instructor. 3 units. *Utku*

335. Mechanical Behavior of Soils. Origin of soils, soil minerals, and processes of soil formation; physical chemistry of multiphase systems and soil structure. Permeability and flow of water through soils: capillary and osmotic phenomena; soil compressibility; theory of consolidation; shear strength and failure criteria. Stress-strain relationships, volume changes, and pore pressure during shear strength properties. Advanced laboratory soil testing techniques. 4 units. *Vesić*

336. Advanced Soil Mechanics. Theories of plastic and elastic equilibrium of soil masses and their application to analysis of problems such as pressure on retaining walls, anchored bulkheads, cofferdams, silos, shafts, and tunnels; stability of slopes; stresses and settlement in soil masses and pavement; piles and pile groups subjected to lateral loads. Prerequisite: C.E. 335. 4 units. *Vesić*

337. Elements of Soil Dynamics. Behavior of soils and foundations under transient and impact loads. Mechanics of pile driving. Foundation vibrations. Effects of explosions on soils: wave propagation, cratering. Earthquake effects on foundations, earth dams, and slopes. Compaction of loose soils by explosives or by vibration. Behavior of layered systems under dynamic loads. Prerequisite: C.E. 335 or consent of instructor. 3 units. *Vesić*

350. Advanced Engineering Analysis. Review of general mathematical properties of boundary value, eigenvalue, and initial value problems in continuum. Alternate equivalent formulations. Comparative survey of approximate methods for reducing continuum problems into equivalent discrete problems for numerical solutions. Prerequisites: Computer Science 221 and 222, or consent of instructor. (Also listed as Computer Science 350.) 3 units. *Utku*

365. Advanced Topics in Civil Engineering. Opportunity for study of advanced subjects relating to programs within the Civil Engineering Department tailored to fit the requirements of a small group. 1 to 3 units. *Graduate Staff*

399. Special Readings in Civil Engineering. Special individual readings in a specific area of study in civil engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff*

ELECTRICAL ENGINEERING

Associate Professor H. Hacker, Jr., *Chairman and Director of Graduate Studies* (130 Engineering); Professors Artley, Kerr, Marinos, Nolte, Owen, Pilkington, Thurstone, and Wilson; Associate Professors Joines and Wang; Assistant Professor George

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid state materials and devices; ferromagnetics; super-conducting circuits; instrumentation; electronics; microwaves; automatic control; energy conversion; digital systems; stochastic systems; and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electromagnetic theory, and network analysis. Students in doubt about their background for enrollment in specific courses should discuss the matter with the

Director of Graduate Studies. The M.S. degree program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. degree program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

A program in stochastic systems analysis is offered in cooperation with the Department of Mathematics at Duke and the Department of Statistics and Mathematics at the University of North Carolina at Chapel Hill. For further details concerning this program, refer to the description under Special and Cooperative Programs.

For Seniors and Graduates

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory: joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. (Also listed as Computer Science 203.) Fall semester. 3 units. *Kerr or Nolte*

204. Information Theory and Communication Systems. Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Prerequisite: E.E. 203. Spring semesters 1976, 1978. 3 units. *Marinos or Nolte*

205. Signal Detection and Extraction Theory. Introduction to signal detection and information-extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Application to problems in communication theory. Prerequisite: E.E. 203 or permission of instructor. (Also listed as Computer Science 205.) Spring semester. 3 units. *Nolte*

208. Digital Computer Design. Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detail design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are also discussed. Prerequisite: E.E. 157 or permission of instructor. Spring semester. (Also listed as Computer Science 208.) 3 units. *Marinos or Owen*

211. Solid State Theory. A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrödinger and matrix formulations, angular momentum, perturbation methods. Maxwell-Boltzmann and Fermi distributions. Prerequisite: permission of instructor. Fall semester. 3 units. *Artley or Hacker*

212. Solid State Materials. Concepts of solid state physics as applied to engineering materials; electric, magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; and superconductors. Prerequisite: E.E. 211. Spring semester. 3 units. *Artley or Hacker*

*213. **Principles of Magnetism.** A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: permission of instructor. 3 units. *Artley or Hacker*

*215. **Semiconductor Physics.** A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: E.E. 211 or permission of instructor. 3 units. *Hacker*

217. **Masers.** Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Prerequisite: permission of instructor. Some laboratory work. Spring semesters 1977, 1979. 3 units. *George*

221. **Nonlinear Networks and Systems.** Characterization of nonlinear multi-terminal network elements; formulation of system equations from topological and energy considerations. Basic properties and general methods of solution of resistive nonlinear networks. Time-varying linear systems. Examination of some fundamental properties of nonlinear differential equations. Spring semester. 3 units. *Wilson*

222. **Nonlinear Analysis.** Introduction to methods of analyzing engineering systems described by nonlinear differential equations—analytic, numerical, graphical, and series approximation methods analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation, oscillations, and forced oscillating systems. (Also listed as M.E. 232.) Fall semester. 3 units. *Wilson*

224. **Integrated Electronics: Analog and Digital.** Application of integrated circuits for analog and digital systems. Topics include the effect of fabrication techniques on circuitry design, a study of differential and operational amplifiers, and consideration of various logic families such as resistor-transistor logic (RTL), diode-transistor logic (DTL), current-mode or emitter-coupled logic (ECL), and transistor-transistor logic (TTL). Prerequisite: E.E. 161 or equivalent. Fall semester. 3 units. *Wilson*

225. **Semiconductor Electric Circuits.** Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Prerequisite: permission of instructor. Spring semester. 3 units. *Joines*

227. **Network Synthesis.** Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Prerequisite: permission of instructor. Fall semesters 1975, 1977. 3 units. *George*

*Offered on demand.

241. Linear Systems. Modeling of multiple input-output linear systems in the frequency and time domains. Matrix differential and difference equations and their solutions; state variables. Digital simulation of differential systems. Fourier analysis of signals and systems. Transform techniques applied to state variable models. State space models of distributed systems. Fall semesters. 3 units. *Kerr or Wang*

242. Modern Control and Dynamic Systems. See course description for M.E. 230. (Also listed as M.E. 230.) 3 units. *Wright*

243. Advanced Linear Systems Theory. Linear spaces and linear operators. Impulse-response matrices. Controllability and observability. Irreducible realizations of rational transfer function matrices. Canonical forms, state estimators, and observer theory. Stability. Linear time-invariant composite systems. Prerequisite: E.E. 241. Spring semesters 1976, 1978. 3 units. *Wang or Kerr*

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. *Staff*

266. Biofeedback Systems. Instrumentation, on-line computer analysis, and models associated with biofeedback systems. Selected readings considered in conjunction with experience in laboratory biofeedback practices. The physical, physiological, and psychological aspects of biofeedback provide a vehicle for experimental learning which relates individual experience to models used in systems theory, field theory, electronics, and communications. Prerequisite: permission of instructor. Spring semester. 3 units. *Artley*

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, force and energy relations. Prerequisite: permission of instructor. Fall semester. 3 units. *Joines*

272. Applications of Electromagnetic Theory. Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; and microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Prerequisite: E.E. 271. Spring semesters 1976, 1978. 3 units. *Joines*

297-298. Thesis Research. 6 units.

For Graduates

304. Estimation, Filtering, and Random Systems. Statistical estimation and filtering techniques applied to signal analysis and system identification. Weiner and Kalman filter theory in the estimation of system state variables and system parameters. Statistical treatment of linear random operators and random differential equations. Applications to communications and control with selected computer exercises. Prerequisite: E.E. 203. Spring semester. 3 units. *Kerr*

305. Advanced Applications of Statistical Decision Theory. Optimum modulators and demodulators, comparison of various sytems. Gaussian signals in Gaussian noise; sonar-radar problem, representation of narrow band processes, slowly fluctuating targets, optimum receiver for estimating

range and Doppler, properties of autocorrelation functions and ambiguity functions, pseudo-random signals, resolution, frequency spreading, reverberation, active sonar, optimum space-time system, and passive sonar. Prerequisite: E.E. 205. Fall semesters 1976, 1978. 3 units. *Nolte*

306. Adaptive Detection and Communication Systems. Sequential detection, Wald's sequential probability ratio test, sequential tests of composite hypotheses, deferred decision theory; adaptive systems, nondecision directed and decision-directed measurements, adaptive on-off communications systems, transmitted reference systems, detection systems employing the learning feature, learning with and without a teacher, pattern recognition. Applications to communication systems. Prerequisite: E.E. 205. (Also listed as Computer Science 306.) Fall semesters 1975, 1977. 3 units. *Nolte*

307. Advanced Digital Systems I. A unified treatment of discrete computational structures. Mathematical foundations of discrete parameter systems: semigroups, groups, rings, and fields. Sequential machines as sequence recognizers. Linear sequential structures. Elements of language theory. Prerequisite: E.E. 157 or permission of instructor. Fall semester. (Also listed as Computer Science 307.) 3 units. *Marinos*

308. Advanced Digital Systems II. A unified treatment of parallel computational structures. Petri nets, flow-graph schemata, parallel computational schemata (PCS), and other models of parallel computations. Actual realizations of parallel computational schemata are presented. Prerequisite: E.E. 157 or permission of instructor. Spring semester. (Also listed as Computer Science 308.) 3 units. *Marinos*

*__313. Magnetic Processes in Materials.__ Selected topics in magnetism. Cryomagnetics, spin wave resonance, interaction of superconductor and ferromagnetic materials, nonlinear spin wave theory, effects of finite dimensions and interfaces on basic properties of ferromagnets. Microwave applications. Prerequisite: E.E. 213 or permission of instructor. 3 units. *Hacker*

321. Nonlinear Magnetic and Semiconductor Circuits. Mathematical description of nonlinear magnetic and semiconductor characteristics; transient and steady-state analysis and synthesis of nonlinear systems with application of such topics as magnetic amplifiers, frequency converters, oscillators, computer logic, switching devices, and inverters. Prerequisite: permission of instructor. Spring semesters 1977, 1979. 3 units. *Wilson*

324. Nonlinear Oscillations in Physical Systems. Analysis of phenomena encountered in free and forced oscillating systems: stability criteria, topological methods, degenerate systems and discontinuous theories, relaxation oscillations, asymptotic approaches. Emphasis on interdependence of physical and mathematical reasoning in analyzing nonlinear electrical and mechanical systems. Illustrative examples selected to meet interests of class. Prerequisite: E.E. 222. Spring semesters 1976, 1978. 3 units. *Wilson*

342. Optimal Control Theory. Optimization problems for dynamic systems. Optimal feedback control. Linear systems with quadratic criteria; mathematical programming; optimal filtering and prediction; optimal feedback control in the presence of uncertainty. Prerequisite: E.E. 241. Spring semesters 1977, 1979. 3 units. *Wang*

345. Stochastic Control Systems. Wiener process, Poisson's processes,

*Offered on demand.

Markov chains, stochastic finite-stage machines and semi-Markovian processes. Stochastic control systems, stability of stochastic systems. Mean square error analysis, Wiener filters, statistical equivalent linearization and identification of control systems by statistical techniques. Fixed-memory, expanding-memory, fading-memory filters and Kalman's filters. Stochastic dynamic programming and optimization of stochastic control systems. Prerequisites: E.E. 203 and 243. Spring semesters 1976, 1978. 3 units. *Wang*

*371. **Advanced Electromagnetic Theory.** An advanced treatment of topics in electromagnetic theory selected from the interests of the instructor and students. Representative topics are propagation in anisotropic media, plasma waves, antennas, and boundary value problems. Prerequisite: E.E. 272. 3 units. *Joines or Hacker*

*373. **Selected Topics in Field Theory.** An advanced treatment of topics in generalized field theory selected from the interests of the instructor and the students. Representative topics are generalized fields, electromagnetic interactions, quantum electrodynamics, inhomogeneous media, and diffusion phenomena. Prerequisite: E.E. 272. 3 units. *Artley or George*

399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff*

MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Professor Chaddock, *Chairman* (142 Engineering); Assistant Professor Buzzard, *Director of Graduate Studies* (143 Engineering); Professors Garg, Harman, Kenyon, Linderoth, Macduff, and Pearsall; Adjunct Professor Roberts; Associate Professors Clark, Cocks, Elsevier, Shepard, and Wright; Adjunct Associate Professor Mayer; Assistant Professor Shaughnessy

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in either mechanical engineering or materials science. Departmental programs of advanced study and research include control systems, dynamics and vibrations, energy conversion, fluid mechanics, heat and mass transport, mechanical design, thermodynamics, physical metallurgy, corrosion, fracture, and polymer science. The faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in areas which include applied mechanics, biomechanics, biomedical materials, environmental quality and control, interaction of fields and materials, ocean engineering, systems engineering, engineering and public policy, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. A major emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

202. Theoretical Thermodynamics. Review of classical thermodynamics. Thermodynamics of continuum properties of real substances. Analysis of energy conversion with internal irreversibility and advanced engineering problems. Introduction to the statistical basis of thermodynamics. 3 units. *Harman*

210. Intermediate Dynamics. Comprehensive treatment of space kine-

*Offered on demand.

matics, kinetics of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible continuous systems. (Also listed as C.E. 210.) 3 units. *Macduff or J. F. Wilson*

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention to recent developments in the processing and use of modern plastics and fibers. 3 units. *Clark or Pearsall*

213. Advanced Materials Science. Current problems in materials science. Thermal, electrical, optical, and magnetic properties of materials in terms of basic physical concepts. Synthesis of solid materials and manipulation of their properties. Prerequisites: Engineering 83 and M.E. 111 or 112. 3 units. *Cocks, Pearsall, or Shepard*

214. Corrosion and Corrosion Control. Environmental aspects of the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. 3 units. *Cocks or Shepard*

215. Failure Analysis and Prevention. A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or permission of instructor. 3 units. *Cocks or Shepard*

221. Compressible Fluid Flow. Basic concepts of the flow of gases from the subsonic to the hypersonic regime. Effects of friction, heat transfer, and shock on one-dimensional inviscid flow. Potential theory, oblique shock waves, and special calculation techniques in two-dimensional flow. 3 units. *Harman*

222. Heat Transfer. Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. 3 units. *Buzzard or Chaddock*

224. An Introduction to Turbulence. Flow instability and the transition to turbulence. Physical characteristics of turbulent flows, averaging, and the Reynolds equation. Turbulent transport and mixing length theories. The statistical description of turbulence, correlations, and spectra. Fourier transforms. Measurement techniques. 3 units. *Shaughnessy*

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. Prerequisite: M.E. 126. 3 units. *Shaughnessy*

230. Modern Control and Dynamic Systems. The state space point of view is used as a vehicle to integrate the classic control and modern systems techniques. Topics include vector differential equations, modal matrix trans-

formation, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. (Listed also as E.E. 242.) 3 units. *Garg or Wright*

231. Systems Response and Control. Methods, applicable to design, of obtaining parameters for strength, response, and stability studies of mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. 3 units. *Macduff or Wright*

232. Nonlinear Analysis. (Listed also as E.E. 222.) Fall semster. 3 units. *T. Wilson*

233. Fluid Control Systems. A design-oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; d.c. and a.c. hydraulic and pneumatic amplifiers. 3 units. *Macduff*

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. 3 units. *Macduff*

236. Engineering Acoustics and Noise Control. Specification of physical properties of noise, noise measurement, and absorption, transmission, and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personnel protectors. Prerequisites: M.E. 123 and Mathematics 111. 3 units. *Macduff*

251. Refrigeration and Cryogenics. Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Simultaneous heat and mass transfer in refrigeration. Production of low and very low temperatures. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. 3 units. *Chaddock*

255. Energy Conversion. Principles, thermodynamics, and classification of energy conversion devices. Introduction to semi-conductors, thermoelectric generators, photovoltaic generators, thermionic generators, magneto-hydrodynamic generators, fuel cells, and other energy conversion devices. 3 units. *Harman*

265. Advanced Topics in Mechanical Engineering. Study of advanced subjects in mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and the instructor under whom work will be done. 1 to 3 units. *Graduate Staff*

270. Theory of Lubrication and Bearing Design. A study and analysis of the theory of hydrodynamic and hydrostatic lubrication. An examination of dynamics of bearing loading, bearing design and materials. Properties of lubricants. Students will work on real bearing problems taken from industry,

construction equipment, transportation and wherever relative motion is required between adjacent surfaces. 3 units. *Linderoth*

280. Nuclear Reactor Power Cycles. Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety, shielding, heat transfer, fluid flow, and materials problems unique to reactor design. 3 units. *Kenyon*

300. Advanced Projects in Mechanical Engineering. This course may be elected by students enrolled in a non-thesis program leading to the Master of Science degree. 3 units. *Graduate Staff*

302. Advanced Thermodynamics. Classical thermodynamics of inherently irreversible processes. Quantum and statistical thermodynamic analysis of properties of real substances and processes. Principles of general thermodynamics. 3 units. *Harman*

309. Advanced Dynamics. (Also listed as C.E. 309.) 3 units. *J. F. Wilson*

311. Behavior of Crystalline Solids. An advanced treatment of the dependence of structure on atomic bonding, and of properties on structure in crystalline solids. Crystal structures; phase diagrams and solid-state thermodynamics; physical properties; mechanical properties; kinetics of thermal treatments. 3 units. *Cocks, Pearsall, or Shepard*

322. Mechanics of Viscous Fluids. Equations of motion for a viscous fluid; general properties and selected solutions of the Navier-Stokes equations; laminar boundary layer equations with selected solutions and approximate techniques; origin of turbulence. 3 units. *Buzzard*

323. Convective Heat Transfer. Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, and condensation heat and mass transfer. Prerequisite: Math. 285. 3 units. *Chaddock*

324. Conduction and Radiation Heat Transfer. Conduction heat transfer in steady and transient state. Radiation exchange involving absorbing and emitting media including gases and flames, combined conduction and radiation and combined convection and radiation. Exact and approximate methods of solution including separation of variables, transform calculus, numerical procedures, and integral and variational methods. Prerequisites: Math. 285, M.E. 222 or equivalent. 3 units. *Buzzard or Chaddock*

327. Homogeneous Turbulence. Stochastic methods in turbulence theory. The kinematics of homogeneous turbulence. The dynamics of decay, universal equilibrium theory, and the probability distribution of velocity. 3 units. *Shaughnessy*

328. Turbulent Shear Flow. The Reynolds equation and the energy balance. Turbulent transport processes. Flow in channels and pipes. The turbulent boundary layer. Free turbulence: jets, wakes, and mixing layers. Recent theoretical and experimental work. 3 units. *Shaughnessy*

331. Nonlinear Control Systems. Analytical, computational, and graphical techniques for solution of nonlinear systems; Krylov and Bogoliubov asymptotic method; describing function techniques for analysis and design;

Liapounov functions and Lure's methods for stability analysis; Aizerman and Kalman conjectures; Popov, circle, and other frequency-domain stability criteria for analysis and synthesis. Prerequisite: M.E. 230 or permission of instructor. *Garg or Wright*

333. Seminar in Control Systems. Modern developments from the areas of system dynamics, linear, nonlinear, and optimal control; computational techniques for system analysis and synthesis; emphasis on recently published writing in the controls field; topics to be selected to match the interests of the student group; term paper required. Prerequisites: knowledge of basic linear control theory, computer programming, or permission of instructor. 3 units. *Garg*

335. Analytical Methods in Vibrations. Time and frequency domain analysis, generalized coordinates and Lagrange's equations, natural modes of continuous systems, approximate methods, damped systems, introduction to random vibrations. Prerequisite: M.E. 235 or permission of instructor. 3 units. *Wright*

372. Finite Element Techniques in Design. Finite element methods applied to design problems in stress analysis; temperature distribution; and flow problems. Derivation of state vectors and transfer matrices for rectangular and triangular elements; accuracy and computation methods; comparison with difference equation methods and available analytical results. 3 units. *Macduff*

399. Special Readings in Mechanical Engineering. Individual readings in advanced study and research areas of mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Faculty*

English

Professor Budd, *Chairman* (323 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Professors Anderson, Cady, Duffey, Ferguson, Randall, Reiss, Ryals, Smith, Turner, and Williams; Associate Professors Clubbe, Gerber, Jackson, Jones, Mellown, Monsman, and Strandberg; Assistant Professors Butters and DeNeef

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D. degree, two languages determined by the student's committee.

For Seniors and Graduates

207, 208. History of the English Language. First semester, Old English grammar and readings; second semester, the development of Middle English and Modern English. 3 units per semester. *Nygard or Reiss*

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. 3 units. *Butters, Nygard, or Reiss*

210. Old English Literary Tradition. 3 units. *Nygard or Reiss*

212. Middle English Literary Tradition. 3 units. *Nygard or Reiss*

215, 216. Chaucer. Reading and interpretation of *The Canterbury Tales* in the first semester; of *Troilus and Criseyde* and the minor poems in the second. 3 units per semester. *Nygard or Reiss*

221. English Prose of the Sixteenth Century. Readings in the major forms and authors. 3 units.

222. English Non-Dramatic Poetry of the Sixteenth Century. Extensive select readings from representative types and authors excluding Spenser. 3 units. *DeNeef*

223. Spenser. A study of his works. 3 units. *DeNeef*

224. Shakespeare. The plays. 3 units. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. The first semester includes Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. The second semester, which emphasizes Jonson, is devoted also to Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. 3 units per semester. *Randall*

229, 230. English Literature of the Seventeenth Century. Major works in prose and poetry from 1600 to the death of Dryden. 3 units per semester. *DeNeef (229), Jackson (230), Randall or Williams (229)*

232. Milton. Milton's poetry and prose, with emphasis on the major poems. 3 units.

234. English Drama, 1642-1800. The heroic play and the comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. 3 units. *Jackson*

235, 236. The Eighteenth Century. Swift, Pope, Defoe, Addison, Steele, and others are studied in the first semester; in the second, Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. 3 units per semester. *Ferguson or Jackson*

241, 242. English Literature of the Early Nineteenth Century. The Romantic poets and prose writers. First semester, 1790-1810, with emphasis on Blake, Wordsworth, and Coleridge; second semester, 1810-1830, with emphasis on Byron, Shelley, and Keats. 3 units per semester. *Clubbe*

245, 246. English Literature of the Later Nineteenth Century. The first semester is devoted chiefly to Carlyle, Dickens, Thackeray, Tennyson, and Browning; the second semester to Arnold, Ruskin, Pater, George Eliot, Meredith, the pre-Raphaelites, and Swinburne. 3 units per semester. *Clubbe, Monsman, or Ryals*

251, 252. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. The first semester will include Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence; the second semester, Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. 3 units per semester. *Mellown or Smith*

263, 264. American Literature, 1800-1865. The writers emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. 3 units per semester. *Anderson, Budd, Jones, or Turner*

267, 268. American Literature, 1865-1915. Selected works of representa-

tive authors. First semester: Whitman, Twain, James, Howells, Dickinson, and the Local Colorists. Second semester: Crane, Norris, Dreiser, Cather or Wharton, O'Neill, Robinson, and Frost. 3 units per semester. *Budd or Cady*

270, 271. Southern Literature. Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Twain, Glasgow, and Faulkner. 3 units per semester. *Turner*

275, 276. American Literature Since 1915. First semester, selected fiction from Gertrude Stein to the present. Second semester, poetry from the Imagist movement to the present. 3 units per semester. *Duffey or Strandberg*

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. 3 units. *Nygard*

285. Literary Criticism. A study of the Greek and Roman critics, in chronological order but with emphasis on their permanent value rather than on the history; also of the Continental and English critics to about 1700. 3 units.

287. Recent Critical Thought. A survey of ideas relevant to the development of modern literature and its cultural relations. 3 units. *Duffey*

289. Literary Biography. Reading and discussion of works by Plutarch, Roper, Walton, Aubrey, Mason, Johnson, Boswell, Lockhart, Carlyle, Froude, Gosse, and Strachey. The development of the literary form, its various methods and theories of its nature and purpose. 3 units.

For Graduates

310. Beowulf. Reading and interpretation of the text. 3 units. *Nygard*

312. Studies in Middle English Literature. The literature of England from 1100 to 1500 (excluding Chaucer); a study of medieval genres with a close reading of selected major works. 3 units. *Nygard or Reiss*

315. Studies in Chaucer. 3 units. *Nygard or Reiss*

318. Medieval Romances. Origins, types, forms, themes; special attention to Arthurian materials. 3 units. *Reiss*

320. Studies in Renaissance English Prose. Close readings in various forms and authors as they reflect the culture and thought of the Renaissance. 3 units.

324. Studies in Shakespeare. Intensive study of carefully limited topics, together with critical analysis and interpretation of selected texts. 3 units. *Williams*

325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. 3 units. *Randall*

329. Studies in the Metaphysical Poets. A careful study of Donne, Herbert, and Vaughan against the seventeenth century background, with some attention to their influence on other writers in the period and their impact on twentieth century poetry. 3 units. *Williams*

330. Studies in Dryden and His Age. The early poems, the important odes, the religious and political poems, selected critical and controversial prose, and the heroic play and tragedy. 3 units. *Jackson*

337. Studies in Swift. Intensive study of the major prose; selected readings in the verse, political writings, and miscellaneous prose. 3 units. *Ferguson*

338. Samuel Johnson's Literary Criticism and Related Topics. 3 units. *Ferguson*

339. The Eighteenth Century Novel. Richardson, Fielding, Smollett, and Sterne are emphasized. Attention is given to earlier prose fiction and to other contributing literary patterns. 3 units. *Ferguson or Jackson*

341. Studies in English Romanticism. 3 units. *Clubbe*

343. Studies in Coleridge and Carlyle. 3 units. *Clubbe*

347. Studies in Victorian Poetry. 3 units. *Monsman or Ryals*

348. Studies in Victorian Fiction. 3 units. *Ryals*

349. Studies in Nineteenth Century Nonfictional Prose. 3 units.

353. Studies in British Poetry of the Twentieth Century. Detailed examination of major poetic texts with background readings in prose. 3 units. *Smith*

361. Studies in a Major American Author of the Early Nineteenth Century. 3 units. *Anderson, Jones, or Turner*

362. Studies in a Major American Author of the Later Nineteenth Century. 3 units. *Budd or Cady*

364. Hawthorne and Melville. Extensive reading in the works of Hawthorne and Melville, and close study of selected writings. 3 units. *Jones or Turner*

368. Studies in American Realistic Fiction. Intensive study of a post-Civil War novelist such as Howells, with lesser attention to a representative precursor such as De Forest, and a twentieth century writer such as Dreiser. 3 units. *Budd or Cady*

369. Studies in American Humor. The native tradition in the Down-East humorists and the humorists of the Old Southwest, in Mark Twain and his contemporaries, and afterward. 3 units. *Turner*

376. Studies in Twentieth Century American Literature. Selected problems posed by the poetry, prose, fiction, or drama of this century. 3 units. *Duffey*

380. The Traditional Ballad and Folksong. Studies in English, Scottish, and American popular poetry, with attention to the textual and musical traditions. No technical knowledge of music is required. 3 units. *Nygard*

383. Textual Criticism. The principles of analytical bibliography and their application to problems and procedures in the study of Elizabethan printed books. 3 units. *Williams*

387. Special Topics Seminar. 3 units. *Staff*

100. English for Foreign Students. A non-credit course which includes an individual tutorial stressing writing and a small class emphasizing conversation and pronunciation. The tutorial is restricted to registered undergraduate and graduate foreign students.

Forestry and Environmental Studies

Professor Ralston, *Dean* (213 Biological Sciences Building); Professor Anderson, *Director of Graduate Studies* (04 Biological Sciences Building); Pro-

fessors Barnes, Hellmers, Knoerr, Philpott, and Stambaugh; Associate Professor Yandle; Adjunct Associate Professors Clark, Hodges, Metz, and Vukovich; Assistant Professors Convery, Rajagopal, Sullivan, and Wuenscher

Major and minor work is offered in the natural and social aspects of forestry and related areas of natural resources leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees. Work for these degrees may be pursued in the biological science areas of dendrology, wood anatomy, forest ecology, tree physiology, biochemistry, forest entomology, and forest pathology; in the environmental science areas of forest soils, meteorology, and hydrology; in resource economics; and in forest mensuration, biometry, and operations research. College graduates who have had specialized training in professional forestry or the related basic areas of the natural or social sciences will be considered for admission. Students will be restricted to the particular fields of specialization for which their academic background qualifies them. For information on professional training in forestry, the *Bulletin of the School of Forestry and Environmental Studies* should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the A.M. (with or without a thesis), M.S. (with a thesis), and the Ph.D. Students majoring in forestry may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Ph.D. degree. More information on degree and language requirements can be found in the program information section of the *Bulletin*.

BIOLOGICAL SCIENCE

Dendrology and Wood Anatomy

206. Anatomy of Woody Plants. (Also listed as Botany 206.) 4 units. *Philpott*

241. Dendrology. Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisites: Biology 1-2 or equivalent. 3 units. *White*

292. Microtechnique of Woody Tissue. Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 290 or equivalent. 3 units. *Philpott*

Ecology

243. Natural Resource Ecology. An introduction to modern ecology as applied to natural resource management and environmental protection. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: permission of instructor. 3 units. *Wuenscher*

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced level course in nonmarket decision-making or Forestry 378 or its equivalent. 1 unit. *Convery*

337. Ecological Analysis for Environmental Management. Methods of analyzing ecosystems for environmental impact assessment, land use planning, and other environmental management applications. Lectures, laboratory, and field work in use of maps, aerial photographs, and field surveys for interpre-

tation of physiographic and biological characteristics of terrestrial ecosystems. Prerequisites: Environmental Studies 243 and 341 and consent of instructor. 3 units. *Sullivan or Wuenscher*

340. Ecology and Land Use Planning. Consideration of the properties and processes of the natural environment as they relate to land use. Exploration of the biological, economic, legal, and social aspects of the application of ecological principles to the land use planning process. Prerequisites: Environmental Studies 341 and consent of instructor. 3 units. *Wuenscher*

341. Ecological Principles in Environmental Management. Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Environmental Studies 243 or other substantive course work in ecology. 3 units. *Wuenscher*

346. Seminar in Environmental Policy. Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: Forestry 269 and Environmental Studies 341 or their equivalents and consent of instructor. 1 unit. *Convery or Wuenscher*

347, 348. Natural Resource Ecology—Environmental Management Seminar. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. 1 unit per semester. *Knoerr or Wuenscher*

354. Quantitative Analysis of Ecological Environmental Systems. (See description under Statistics and Operations Research.)

Entomology

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson or Stambaugh*

225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 units. *Barnes*

230. Forest Entomology. Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent or consent of instructor. 3 units. *Anderson*

233. General Entomology. Principles of morphology, physiology, metamorphosis, and taxonomy of insects. Prerequisite: one course in entomology or zoology or consent of the instructor. 4 units. *Anderson*

331. Toxicology of Insecticides. Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. 3 units. *Anderson*

332. Ecology of Forest Insects. The influence of environmental factors

on the vital processes of insects with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology or consent of the instructor. 3 units or 4 units with laboratory. *Anderson*

335. Entomological Research Techniques. Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. *Anderson*

385. Seminar in Forest Protection. Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. *Anderson or Stambaugh*

Pathology

222. Biology of Forest Insects and Diseases. (See description under Entomology.)

223. Forest Pathology. Survey of major diseases of North American forests and their timbers, with emphasis on current literature. Field and laboratory study in diagnosis and infection biology. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 4 units. *Stambaugh*

225. Chemical Aspects of Forest Protection. (See description under Entomology.) 3 units. *Barnes*

321. Phytopathological Technique in Forestry. Fundamentals of phytopathology and their application to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. *Stambaugh*

322. Microbiology of Forest Soils. Qualitative and quantitative characterization of the microbial populations of forest soils with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisite: consent of instructor; mycology or bacteriology is recommended. 3 units. *Stambaugh*

385. Seminar in Forest Protection. (See description under Entomology.)

Physiology and Biochemistry

205. Tree Growth and Development. Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. *Barnes*

207. Chemistry of Woody Tissues. Composition of wood at the elemental, molecular, and macromolecular levels; both in woody plants and in processed woods. Distribution and properties of main components, and methods of analysis. Prerequisite: organic chemistry or consent of instructor. 3 units. *Barnes*

208. Physiology of Wood Formation. Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. *Barnes*

225. Chemical Aspects of Forest Protection. (See description under Entomology.) 3 units. *Barnes*

305. Forest Biochemistry. Biochemistry applied to structure and function of woody plants and associated fungi and insects. Prerequisites: courses in plant physiology and chemistry. 3 units. *Barnes*

ENVIRONMENTAL SCIENCE

Soils

261. Forest Soils. Origin, development, and classification of soils with special emphasis on those developed in humid climates; morphological, physical, and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2, and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. *Ralston*

362. Forest Soil Physics. Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural characteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. 3 units. *Ralston*

364. Soil Classification and Mapping. Classification of soils as natural bodies. Mapping of soils, land use classes, and forest site classes; field study will be made of soils in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. *Ralston*

366. Forest Soil Fertility. The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 262; analytical chemistry is recommended. 3 units. *Ralston*

Meteorology

203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. *Vukovich*

204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. *Knoerr*

215. Air Pollution Meteorology. The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring, and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: introductory course in general meteorology, Forestry 203 or equivalent. Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from North Carolina State University. 3 units. *Staff*

217. Environmental Instrumentation. Theory and application of the physical basis for measuring parameters of natural and controlled environments.

Properties and effective utilization of contemporary electronic measurement and data acquisition systems. Methods for obtaining and processing computer compatible experimental records. Three lectures and three laboratory hours per week. Prerequisite: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. *Knoerr*

***304. Atmospheric Turbulence and Diffusion.** Bulk and molecular aspects of atmospheric turbulence. Navier-Stokes equations and the Reynold's stresses. Mixing-length and statistical turbulence theories. Similarity hypotheses. Turbulent transfer and diffusion in adiabatic and diabatic atmospheres. Characteristics of turbulence in various scales of motion from the planetary to subinertial range. Prerequisites: Forestry 203 and differential equations or consent of instructor. 3 units. *Vukovich*

***306. Dynamics of Local Atmospheric Motion.** Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves and local modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations or consent of instructor. 3 units. *Vukovich*

***344. Advanced Topics in Micrometeorology and Biometeorology.** Selected topics in the physics of the earth's surface environment with emphasis on plant and animal microclimates; budgets of energy, mass and momentum; vertical structure of wind, temperature, water vapor, and carbon dioxide in relation to exchange processes within the biosphere. Prerequisite: Forestry 204 or equivalent and consent of instructor. 2 units. *Knoerr*

Hydrology

216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of streams. Techniques and research methods used to control the hydrologic cycle, water quality and water yield on wild lands. 3 units. *Hellmers*

***342. Hydrologic Processes.** Physical processes of the hydrologic cycle with emphasis on those processes which can be modified or controlled by watershed management. 3 units. *Knoerr*

RESOURCE ECONOMICS AND POLICY

269. Resource Economics and Policy. Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. 3 units. *Convery*

270. Economics of Forestry. Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services: problems of the economics of the firm and industry, basic and peculiar to forestry, with special attention to the time dimensions of value; the role of forestry in the general economy including attention to relevant institutional factors. Prerequisite: Forestry 269 or one course in the principles of economics. 3 units. *Convery*

*Offered on demand.

273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. *Convery*

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for government policies in private property economics. Prerequisite: an advanced level course in non-market decision-making or Forestry 378 or its equivalent. 1 unit. *Convery*

378. Seminar in Forest Economics. Examination and discussion of the application of economic concepts in forestry, the potential contribution of economic analysis to private and public forest management; current research in forest economics. Prerequisites: Forestry 270 or consent of the instructor; advanced courses in economics and economic theory are desirable. 2 units. *Convery*

STATISTICS AND OPERATIONS RESEARCH

250. Biometry. Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. *Yandle*

251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 units. *Yandle*

253. Computer Science in Natural Resources. Components and organization of a computer system; automatic programming languages; storage and retrieval systems (TSAR); equation fitting by iteration and least squares methods; graphical techniques. 3 units. *Rajagopal*

258. Operations Research. Mathematical model formulation and development of techniques to aid decision-making in problems of natural resource allocation and use. Includes the theory and techniques of inventory control, equipment replacement planning, queuing theory, competitive strategies, allocation, sequencing and dynamic programming. Consideration is given to both deterministic and non-deterministic models. 3 units. *Rajagopal*

352. Theory and Applications of Linear Statistical Models. Theoretical development of the general linear statistical model together with extensions to accommodate linear approximation of non-linear cases. Curve fitting techniques are developed with emphasis on applications to natural phenomena. Prerequisite: consent of the instructor. 3 units. *Yandle*

353. Design and Analysis of Experiments. Extension of the theory of estimation and testing for general linear models to include the less than full rank case. Experimental design models such as factorial and incomplete block models are developed as special cases of the general theory. Emphasis is placed

on field and laboratory designs together with appropriate computerized analysis techniques. Prerequisite: Forestry 352. 3 units. *Rajagopal*

354. Quantitative Analysis of Ecological and Environmental Systems. Study of quantitative methods for describing forest ecosystems. Analysis of characteristics and dynamic behavior of biological populations; development and evaluation of mathematical models for ecological, physiological, and environmental systems. Simulation techniques for ecosystem analysis will be considered. Prerequisites: Forestry 204, 253, and 353 and Environmental Studies 243. 3 units. *Rajagopal or Yandle*

SPECIAL STUDIES AND RESEARCH

For. 299. Special Studies in Forestry. Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

E.S. 299. Independent Projects in Environmental Studies. Work at the senior-graduate level to meet the needs of individual students in several areas of environmental studies. Credits and hours to be arranged. *Staff*

1. Environmental Planning
2. Environmental Economics
3. Applied Ecology
4. Environmental Education
5. Environmental Communication and Media
6. Environmental Ethics and Values
7. Environmental Design
8. Environmental Policy

For. 301, 302. Advanced Studies in Forestry. Work on the advanced graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

E.S. 301, 302. Advanced Projects in Environmental Studies. Independent work at the advanced graduate level in areas designated under Environmental Studies 299. *Staff*

357, 358. Research in Forestry. Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged.

1. *Forestry Ecology.* Prerequisite: E.S. 243 or equivalent. *Wuenscher*
2. *Forest Soils.* Prerequisite: Forestry 261 or equivalent. *Ralston*
3. *Silviculture.* Prerequisites: E.S. 243 and Forestry 244 or equivalents. *White*
4. *Forest Management.* Prerequisite: Forestry 281 or equivalent. *Staff*
5. *Forest Economics.* Prerequisite: Forestry 270 or equivalent. *Convery*
6. *Wood Anatomy and Properties.* Prerequisites: Forestry 241 and 206 or equivalents. *Philpott*
7. *Forest Mensuration and Biometry.* Prerequisites: Forestry 250 and 352 or equivalents. *Yandle*
8. *Forest Entomology.* Prerequisite: Forestry 230 or equivalent. *Anderson*
9. *Forest Operations Research.* Prerequisite: consent of instructor. *Rajagopal*
10. *Dendrology.* Prerequisite: Forestry 241 or equivalent. *White*
11. *Forest-Tree Physiology.* Prerequisites: plant physiology, and plant or forest ecology. *Barnes and Hellmers*
12. *Forest Pathology.* Prerequisites: plant physiology and Forestry 223 or equivalents. *Stambaugh*
13. *Forest Meteorology and Hydrology.* Prerequisites: Forestry 203, 342, or equivalents. *Knoerr*
14. *Forest Biochemistry.* Prerequisites: plant physiology and organic chemistry. *Barnes*
15. *Regional Land Use Planning.* Prerequisites: Environmental Studies 337 and 340. *Sullivan*
16. *Environmental Studies.* Prerequisites: consent of instructor. *Staff*

368. Field Seminars. Field studies, consultations, and visits to areas of interest during spring vacation period or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. *Staff*

RELATED COURSES IN OTHER DEPARTMENTS

Many courses available in other departments of the University are related to the biological, environmental, economics and policy, and biometrics and operations research areas of forestry and other natural resources. These courses offered in botany, zoology, biochemistry, chemistry, physics, engineering, mathematics, economics, business administration, sociology, and political science may be utilized by graduate students in the School of Forestry. For a specific listing of pertinent courses available in other departments see the *Bulletin of the School of Forestry and Environmental Studies.*

The University Program in Genetics

Professor Gross, *Director* (Biochemistry); Professors Amos (Microbiology and Immunology) and Guild (Biochemistry); Associate Professors Antonovics (Botany); Boynton (Botany), Gillham (Zoology), Kelley (Biochemistry), C. Ward (Zoology), and Webster (Biochemistry); Assistant Professors Hall (Biochemistry), Harriman (Biochemistry), Kredich (Biochemistry), and F. Ward (Microbiology and Immunology)

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (Nanaline H. Duke Building, Room 151).

For Seniors and Graduates

204. Introductory Genetics. An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organization of the genetic material. Primarily for medical students but graduate students may be admitted with the instructor's permission. (Listed as Biochemistry 204.) 2 units. *Gross or Staff*

216. Molecular Genetics. An advanced course on genetic mechanisms and their relationship to nucleic acids and their synthesis. Prerequisites: introductory courses in biochemistry and genetics or consent of instructor. (Also listed as Biochemistry 216.) 4 units. *Guild or Staff*

280. Principles of Genetics. An introduction to the structure and properties of genes and chromosomes and to the evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics. (Also listed as Botany 280 and Zoology 280.) 3 units. *Antonovics, Boynton, or Gillham*

282. Experimental Genetics. A series of laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. May be taken concur-

rently with Genetics 280. Prerequisite: consent of instructor. (Also listed as Biochemistry 282.) 2 units. *Harriman or Staff*

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of instructor. (Also listed as Biochemistry 284.) 1 unit. *Hall or Staff*

285. Population Genetics. A seminar and lecture course devoted to the analysis of the current literature in population genetics. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed as Botany 285.) 2 units. *Antonovics or Staff*

286. Evolution. Processes of adaptation and evolution in individuals, populations, and genetic systems. (Also listed as Zoology 286.) Not open to students who have had courses previously numbered Zoology 109 or Botany 240. Prerequisite: a course in genetics or consent of the instructor. 3 units. *Antonovics, Lundberg, or H. Wilbur*

287. Quantitative Genetics. Methods of analyzing genetic variation in continuous traits. Models of continuous variation, genetic, environmental and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: genetics or Botany 280 or equivalent and consent of instructor. (Also listed as Botany 287.) 3 units. *Antonovics*

288. Seminar on the Role of the Cell in Development and Heredity. Topics of current interest and controversy. Prerequisites: a course in genetics and permission of instructor. (Also listed as Anatomy 288 and Zoology 288.) 2 units. *Counce*

For Graduates

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Test for histocompatibility including lymphocyte interaction and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed as Microbiology and Immunology 336.) 2 units. *Amos or Ward*

351-352. Genetics Seminar. Required of all students specializing in genetics. (Also listed as Biochemistry 351-352.) 1 unit per semester. *Harriman or Staff*

Geology

Professor Heron, *Chairman* (119 Science Building); Associate Professor Perkins, *Director of Graduate Studies* (111 Science Building); Professor Pilkey; Associate Professors Furbish and Lynts; Lecturer Shuart

The Department of Geology offers graduate work leading to the M.S. degree. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and structural geology. In addition he must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of oceanography, sedimentology, stratigraphy, paleontology, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for the M.S. degree.

For Seniors and Graduates

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary process. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. This course is not open to students who have completed Geology 206. Given at Beaufort only. 6 units. *Pilkey*

206. Principles of Geological Oceanography. A survey of many geological aspects of the oceans including sediment types, processes of sedimentation, geological structures of the ocean basins, and bottom physiography. Prerequisite: Geology 213 or consent of instructor. 3 units. *Pilkey*

208. Shallow-Marine Geology. Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marine environment. Prerequisite: Geology 108 or consent of instructor. 3 units. *Perkins*

211. Stratigraphic Principles and Applications. Survey of stratigraphic principles with an emphasis on their application to the solution of stratigraphic problems. Discussions of case histories from the literature. Prerequisite: Geology 108. 3 units. *Perkins*

212. Facies Analysis. Application of modern sedimentological models to the environmental interpretation of sedimentary sequences. Prerequisite: Geology 211. Given biennially. 3 units. *Perkins*

213. Sedimentology. The parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisite: Geology 108 or consent of instructor. 3 units. *Pilkey*

214. Sediments in Thin Section. The study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Interpretation of rock textures and their genesis will be emphasized. Prerequisite: Geology 213 or consent of the instructor. 3 units. *Perkins*

222. Sedimentary Minerals. Structure and geologic occurrences of selective detrital and authigenic minerals including the clay minerals. Theory and use of X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. Prerequisite: Geology 102 or consent of instructor. 3 units. *Heron*

***229. Economic Geology.** Principles and processes involved when elements are concentrated to economic proportions in magmatic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisites: Geology 102. 2 units. *Furbish*

230. Principles of Structural Geology. Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. Given biennially. 3 units. *Staff*

233. Geochemistry. Application of the principles of chemistry to the solu-

*Offered on demand.

tion of problems in geology. Prerequisites: Geology 102 and Chemistry 12. 3 units. *Staff*

241-242. Invertebrate Paleontology. Biologic and stratigraphic relationships of fossil invertebrates, with special emphasis on evolutionary trends of invertebrates as interpreted from fossil evidence. Prerequisite: Geology 2 or consent of instructor. Given biennially. 3 units per semester. *Lynts*

243-244. Micropaleontology. Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution and stratigraphic distribution. Prerequisite: Geology 242 or consent of instructor. Given biennially. 3 units per semester. *Lynts*

247. Paleoecology. Application of ecologic and geologic principles to the reconstruction of the interrelationship between organisms and their environment in geologic time. Prerequisites: Geology 213, 242 or consent of instructor. Given biennially. 3 units. *Lynts*

For Graduates

***300. Seminar in Oceanography.** 1 to 3 units. *Staff*

305. Seminar in Continental Drift and Global Tectonics. Given biennially. 3 units. *Lynts*

***310. Seminar in Stratigraphy.** 1 to 3 units. *Staff*

***312. Seminar in Sedimentology.** 1 to 3 units. *Staff*

***320. Seminar in Mineralogy.** 1 to 3 units. *Staff*

***330. Seminar in Geochemistry.** 1 to 3 units. *Staff*

***340. Seminar in Paleontology.** 1 to 3 units. *Staff*

***350. Seminar in Geomathematics.** 1 to 3 units. *Staff*

***371, 372. Advanced Topics in Geology.** To meet the individual needs of graduate students for independent study in various environmental sedimentary fields. 1 to 3 units. *Staff*

Germanic Languages and Literature

Professor Phelps, *Chairman and Director of Graduate Studies* (102 Foreign Languages); Professor Salinger; Associate Professors Borchardt and Novak; Assistant Professors Alt and Stern

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect to major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second-year) of college German with acceptable grades.

For Seniors and Graduates

201, 202. Goethe. A study of his life and works in the light of his lasting significance to Germany and world literature. First semester: lyrics, prose fiction, and selected dramas; second semester: *Faust I* and *II*. 3 units per semester. *Novak, Phelps, or Salinger*

*Offered on demand.

203, 204. Eighteenth Century. Eighteenth century German literature in its relation to European intellectual currents of that time. 3 units per semester. *Phelps*

***205, 206. Middle High German.** The language and literature of Germany's first classical period. 3 units per semester. *Stern*

***207, 208. German Romanticism.** The principal writers of the period of German Romanticism from 1800 to 1850. 3 units per semester.

209, 210. Kleist, Grillparzer, and Hebbel. The development of the drama in Germany and Austria between Schiller and Naturalism. 3 units per semster. *Alt or Salinger*

211, 212. Nineteenth Century Literature. From the end of Romanticism through Realism. 3 units per semester. *Alt*

213. Heinrich Heine. A study of the German poet and his impact upon his age. 3 units. *Salinger*

214. The Twentieth Century. Literature from the turn of the century to the present through representative authors. 3 units.

***215. Seventeenth Century Literature.** A study of the leading writers of the Baroque, viewed against the background of their time. 3 units. *Borchardt*

216. History of the German Language. The development of the phonology, morphology, and syntax of German from earliest beginnings to the present. 3 units. *Stern*

***217. Renaissance and Reformation Literature.** The period from 1400 to about 1600. 3 units. *Borchardt*

***218. The Teaching of German.** A survey of modern teaching techniques: problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. 3 units. *Phelps*

***219. Applied Linguistics.** The application of modern linguistic principles to a systematic study of the phonetics, morphology, and syntax of modern German. Prerequisite: permission of the instructor. 3 units. *Stern*

***232. Criticism.** Critical concepts, craft of interpretation, and readings from the great critics. 3 units. *Alt or Borchardt*

***233. Advanced Composition.** Intensive study of syntax; practice in the writing of German prose, aiming toward the development of an expressive and fluent style. 3 units.

For Graduates

***301. Gothic.** 3 units. *Stern*

***316. The Austrian Novel from 1930 to the Present.** Studies in the novels of Herman Broch, Robert Musil, and Heimito von Doderer. 3 units. *Salinger*

321, 322. Germanic Seminar. 3 units per semester. *Alt, Phelps, Salinger, or Stern*

—. Graduate Reading Course. An intensive course in German to develop rapidly the ability to read German in several fields. Graduate students only. No credit.

*Offered on demand.

Related Courses in Other Departments

The following courses in other departments are recommended to students who are majoring in Germanics, as particularly valuable in building a proper background for Germanic studies.

a. Graduate courses in foreign or comparative literature or philology, offered by the ancient and modern language departments, to be selected after consultation with the Germanic Languages Department.

b. Graduate courses in history and philosophy, offered by those departments, to be selected after consultation with the Germanic Languages Department.

Health Administration

Associate Professor Jaeger, *Chairman* (263 Baker House); Assistant Professor Smith, *Director of Graduate Studies* (234-B Baker House); Professor Sessoms; Associate Professors Minniear and Swanson; Adjunct Associate Professors Coulter and Peck; Assistant Professor Delaney; Adjunct Assistant Professor Kaluzny; Lecturers Steinert, Warren, and Winfree; Research Associate Falcone

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty month academic program that leads to the M.H.A. degree. Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study. As requirements for participation differ somewhat from the basic admission requirements of the Graduate School, interested individuals should obtain complete information about the program directly from the Chairman.

301. The Health System and Its Environment. An introduction to the organization and management of health services from a systems perspective. Emphasis is on the evolution of the present system and on the interplay of forces within the system and between the system and its environment. 4 units.

312. Comparative Health Systems. A comparative examination of the structure and performance of the health systems of the United States and other countries, particularly Canada and Great Britain. Topics include current financing, capitalization, utilization, control, and the relative roles of the governmental and private sectors. 2 units.

314. Social Dimensions of Health Services. An examination of the dynamics of health and disease in different population groups and their implications with regard to the structure and operation of health care delivery systems. 2 units.

322. Public Policy and Health Care. A study of the development and present status of selected public policy issues within their social, economic,

*Offered on demand.

and political contexts. Alternative courses of possible public action are reviewed and their probable outcomes are assessed. 2 units.

324. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. 4 units.

326. Health Economics. The economics of health and medical care. The problems of demand and supply in health services. Implications of private and public financing. Restrictions on manpower entry; incentives and mobility. Problems of productivity measurement and changes. 2 units.

331, 332. Planning Health Services. A basic two-course sequence in the planning for the delivery of health services, both at the systems level and at the level of institutions and programs. Includes analytic techniques; case studies; and planning simulation. 4 units each term.

335. Ambulatory Health Services. This course covers the noninstitutional components of the organization and provision of personal health services. The principal emphasis is on medical group management, including forms of organization, financing of services, physician-patient relationships, medical records, and peer review. Other topics include dental care, home care, halfway houses, multiphasic screening, and community health and mental health centers. 3 units.

341, 342. Case Studies in Health Administration. An integrating course sequence consisting of analysis of cases taken from institutional and programmatic health services settings. 3 units per semester.

346. Community Health Services. The focus of this course is the organization and management of health services directed toward general populations rather than individuals. Coverage includes aspects of environmental and occupational hygiene, nutrition and housing, planning community health services, preventive health education and programs, and other public health activities. Included are the problems associated with health status measurements and assessment. 3 units.

348. Legal and Regulatory Constraints on Health Services. This course treats the legal relationships between elements of the health system and the larger society of which it is a part. Attention is devoted to the certification, operation and performance of health manpower, organizations, and services, and the difficulties in establishing effective restraints to minimize undesired results. The approach to the course includes the study of selected legislation, court cases, and research findings that assist in understanding formal constraints that affect the operation of the health systems. 2 units.

350. The Administrative Residency (Basic). The basic administrative residency is a period of training that is individually designed and provides a significant set of participatory experiences in various components of the health care system. The two purposes of the residency are to broaden the student's knowledge of the actual operation of the system and to further improve the student's ability to utilize in real settings the skills developed during the academic phase of training. Credit to be arranged.

360. Seminars in Health Administration. A series of seminars held at the end of each quarter during the administrative residency. The seminars are designed to complement the experience obtained during the residency and to add depth to the material covered during the academic phase of the program. Credit to be arranged.

371, 372. Directed Research. Credits to be arranged.

380. Administrative Residency (Advanced). This traineeship represents an optional experience available to the student with special professional objectives. Credit to be arranged.

History

Professor Durden, *Chairman* (235 Allen); Professor A. Scott, *Director of Graduate Studies* (237 Allen); Professors Acomb, Alden, Ferguson, Holley, Hollyday, Lerner, Oates, Parker, Preston, Ropp, W. Scott, Silberman, TePaske, Watson, and Young; Associate Professors Brieger, Cell, Chafe, Davis, Hartwig, Mauskopf, Miller, Nathans, and Witt; Assistant Professors Bergquist, Calkins, Dirlik, Gavins, and Goodwyn; Visiting Associate Professor Gough

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge of at least one ancient or modern foreign language related to his program of study and have completed successfully a substantial research paper, normally the product of a year's seminar or two semester-courses. The paper must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and supervised by April 15; those anticipating a September degree must have their papers read and approved by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepare himself for examination in four fields. Three usually shall be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early modern Europe, modern Europe, American history, Britain and the Commonwealth, Imperial Russia, modern Russia, Latin America, South Asia, traditional China, modern China, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative usually would take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Students may receive credit for either semester of a hyphenated course without taking the other semester if they obtain written permission from the instructor and the Director of Graduate Studies.

For Seniors and Graduates

201-202. Aspects of Change in Pre-Revolutionary Russia. Origin and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of the labor movement. 6 units. *Miller*

203. The Uses of History in Public Policy Making. (Also listed as Public Policy Sciences 271.) 3 units. *Staff*

209-210. Selected Topics in Afro-American History, 1619-Present. Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. 6 units. *Gavins*

212. Recent Interpretations of United States History. A course designed to encourage a critical evaluation of major issues in United States history through examination of recent interpretations of key problems. (Offered in double class meetings during the first half of the spring semester.) 3 units. *Watson or Staff*

215-216. The Diplomatic History of the United States. 3 units per semester. *Davis*

221. Problems in the Economic and Social History of Europe, 1200-1700. 3 units. *Witt*

222. Problems in European Intellectual History, 1250-1550. 3 units. *Witt*

223, 224. The Old Regime, the Enlightenment, and the French Revolution. Political, social, and intellectual trends in seventeenth and eighteenth century Europe, with emphasis on France and the French Revolution. 6 units. *Acomb*

227-228. Recent U.S. History: Major Political and Social Movements. 6 units. *Chafe*

229. Recent Interpretations of Modern European History. A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern European history. 3 units. *Colton or Parker*

231, 232. Problems in the History of Spain and the Spanish Empire. 3 units per semester. *TePaske*

237. Europe in the Early Middle Ages. 3 units. *Young*

238. Europe in the High Middle Ages. 3 units. *Young*

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and the musical and artistic traditions. 3 units. *Hartwig*

241-242. Modernization and Revolution in China. 6 units. *Dirlik*

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation with special emphasis on changes in social and economic life. 3 units. *Calkins*

248. History of Modern India and Pakistan, 1857 to the Present. 3 units. *Calkins*

249-250. Social and Intellectual History of the United States. The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. 6 units. *Holley*

253-254. Modern European Intellectual History. 6 units. *Parker*

255-256. Problems in African History. 6 units. *Hartwig*

260. Economic History of Japan. (Also listed as Economics 232.) 3 units. *Bronfenbrenner*

261-262. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and policies of the Soviet state. 6 units. *Lerner*

263-264. American Colonial History and the Revolution, 1607-1789. The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. 6 units. *Alden*

265, 266. Problems in Modern Latin American History. 3 units per semester. *Bergquist*

267-268. From Medieval to Early Modern England. The intellectual, social, and political problems of the transition to modern England, with special emphasis on the English Renaissance. 6 units. *Ferguson*

269-270. British History, Seventeenth Century to the Present. Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class-consciousness, Victorianism, and the impact of war in the twentieth century. 6 units. *Cell*

273-274. Topics in the History of Science. Studies of critical stages in the evolution of scientific thought as well as of their intellectual context. 3 units per semester. *Mauskopf*

277. The Coming of the Civil War in the United States, 1820-1861. 3 units. *Durden*

278. The Civil War in the United States and Its Aftermath, 1861-1900. 3 units. *Durden*

279. Oral History. Techniques of oral history applied to the study of racial attitudes and problems in the United States. 3 units. *Goodwyn*

280. Historiography. Great historians since Herodotus and an examination of recent twentieth century trends. 3 units. *Staff*

283-284. Political and Social Change in the United States, 1789-1860. 3 units per semester. *Nathans*

287-288. History of Modern Japan. Political, economic, and social development of Japan since 1750 with emphasis on factors contributing to Japan's emergence as a modern state. 3 units per semester.

296. Canada from the French Settlement to the Present. Selected problems in the development of Canada and its provinces. 3 units. *Preston or Gough*

297. The British Empire in the Nineteenth Century (from 1783). The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. 3 units. *Preston*

298. The Commonwealth in the Twentieth Century. The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anti-colonialism. 3 units. *Preston*

Ancient History. For courses in ancient history which may be taken for credit in either history or classical studies, see Classical Studies.

Seminars for Graduates

307-308. Seminar in United States History. 3 units per semester. *American History Staff*

317-318. Seminar in the History of Western Europe. 3 units per semester. *Parker and Scott*

371-372. Research seminars to be taken either in conjunction with colloquia listed below or by special arrangement with graduate instructors. When research seminars are not offered, independent research in a desired area may be worked out with the Director of Graduate Studies and the appropriate graduate instructor. Ad hoc colloquia may be worked out in years when a particular 351-352 colloquium is not formally offered; these colloquia do not appear on the official schedule of courses.

401. Seminar on the British Commonwealth. 3 units. *Ball, Preston, or Others of the Committee on Commonwealth Studies*

Colloquia for Graduates

Each colloquium described below deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371.1-372.1, etc.

351.1-352.1. Military History. 3 units per semester. *Ropp*

351.2-352.2. Modern European Intellectual and Cultural History. 3 units per semester. *Parker*

351.10-352.10. Medieval Europe. 3 units per semester. *Young*

351.15-352.15. The English Renaissance. 3 units per semester. *Ferguson*

351.25-352.25. Central Europe, 1849-1914. 3 units per semester. *Hollyday*

351.30-352.30. European Diplomatic History Since 1870. 3 units per semester. *W. Scott*

351.31-352.31. Twentieth Century Europe. 3 units per semester. *Colton*

351.40-352.40. City and Frontier in United States History. 3 units per semester. *A. Scott*

351.45-352.45. Reform and Politics in Nineteenth Century America. 3 units per semester. *Durden*

351.46-352.46. Twentieth Century United States to 1941. 3 units per semester. *Watson*

351.47-352.47. Diplomatic History of the United States. 3 units per semester. *Davis*

351.51-352.51. Hispanic America. 3 units per semester. *TePaske*

351.60-352.60. Soviet History. 3 units per semester. *Lerner*

351.65-352.65. Modernization and Revolution in China. 3 units per semester.

351.70-352.70. Modern South Asia. 3 units per semester.

351.74-352.74. American Colonial History and the Revolution. 3 units per semester. *Alden*

Historiography and the Teaching of History—For Graduates

312. Seminar in the Teaching of History in College. The work in this course is intended to acquaint students with the problems involved in teaching history in college. Required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke. As an alternate method of meeting this requirement, a graduate student may, in cooperation with a member of the faculty, serve a one-semester teaching apprenticeship. Year course. No credit. Supervised by Director of Graduate Studies.

314. Historical and Social Science Methodology. Methods used in historical research with emphasis upon the various social science approaches. 3 units. *Chafe*

History 314 or History 280 is required of all candidates for the Ph.D. degree who are in residence for two years at Duke University.

Independent Study

399. Supervised independent study and reading, with consent of professor. 3 units.

Marine Sciences—The University Program

Professor Costlow, *Director;* Professors Bookhout (Zoology), Johnson (Botany), and Pilkey* (Geology); Associate Professors Barber (Zoology and Botany) and Searles* (Botany); Assistant Professors Baier (Chemistry), Blankley (Botany), Forward (Zoology), Gutknecht (Physiology), Sullivan (Biochemistry), and Sutherland (Zoology)

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are Botany, Chemistry, Geology, and Zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the Duke University *Marine Laboratory Bulletin*. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Duke University *Marine Laboratory Bulletin* for the current schedule of courses.

*In residence at the Marine Laboratory during the summer only.

202. Phytoplankton Systematics. Taxonomy and classification of marine phytoplankton: their general characteristics, phytogeography, life histories, and study techniques. Individual projects. Given at Beaufort. (Listed as Botany 202.) 6 units. *Blankley*

S202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lectures and laboratory. Prerequisite: one course in physiology. Given at Beaufort. (Listed as Zoology 202.) 6 units. *Salmon (University of Illinois)*

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra- and inter-specific relationships; community ecology. Readings, discussions, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology, or the equivalent, and a year of mathematics; some knowledge of statistics will be helpful. Given at Beaufort. (Listed as Zoology 203.) 6 units. *Sutherland*

204. Marine Microbiology. The major groups of marine microorganisms: bacteria, fungi, protozoa, and phytoplankton, their taxonomy, culture, physiology, and ecology. Field and laboratory work with observational and experimental methods on the dynamics of marine microorganisms. Prerequisite: a course in general biological science or botany. Given at Beaufort. (Listed as Botany 204.) 6 units. *Cavaliere (Gettysburg College)*

205. Geological Oceanography. The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary process. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. This course is not open to students who have completed Geology 206. Given at Beaufort only. (Listed as Geology 205.) 6 units. *Pilkey*

211. Marine Phycology. An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. (Listed as Botany 211.) 6 units. *Searles*

212. Membrane Physiology and Osmoregulations. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in aquatic plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport, and metabolism in crustaceans, and the application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. Summer. 6 units. *Gutknecht and Staff*

214. Biological Oceanography. Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Shipboard investigations of the biological productivity of the continental shelf ecosystem. Prerequisite: permission of instructor. Given at Beaufort. (Also listed as Botany 214 and Zoology 214.) 6 units. *Barber*

230. Chemical Pollution of Coastal Waters. Sources and sinks for chemical pollutants and impact on coastal biomes. Laboratory and field experiments to

illustrate problems in verifying the extent of chemical pollution. Analysis of exemplary chemical plants to derive plans for pollution control. Prerequisites: Chemistry 161 and 162, or equivalent; Chemistry 132, or equivalent; and calculus or permission of instructor. Given at Beaufort. (Listed as Chemistry 230.) 6 units. *Baier*

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry, Chemistry 161, 162, or equivalent; statistics, Mathematics 183, or equivalent, or permission of the instructor. Lectures, laboratory work, and field trips. Given at Beaufort. (Listed as Chemistry 240.) 6 units. *Baier*

250. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. Given at Beaufort. (Listed as Zoology 250.) 6 units. *Forward*

274. Marine Invertebrate Zoology. Structure, functions, and habits of invertebrate animals under normal conditions and experimental conditions. Field trips will be made to study, collect, and classify animals in their natural habitats. Prerequisite: college biology. Given at Beaufort. (Listed as Zoology 274.) 6 units. *Staff*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. Given at Beaufort. (Listed as Biochemistry 276.) 6 units. *Sullivan*

278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. Given at Beaufort. (Also listed as Zoology 278.) 6 units. *Bookhout*

Mathematics

Professor Warner, *Chairman* (135C Physics Building); Professor Weisfeld, *Director of Graduate Studies* (230 Physics Building); Professors Carlitz, Murray, Reed, and Shoenfield; Visiting Professor Beals; Associate Professors Burdick, Hodel, Kitchen, Kraines, Moore, Scoville, Smith, and Stackelberg; Adjunct Associate Professor Chandra; Assistant Professors Lees, MacKichan, and O'Fallon

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis involving the use of the computer.

All A.M. and Ph.D. degree candidates are required to pass a compre-

hensive examination in the areas of algebra, analysis, and topology. Students will usually take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. degree candidates are expected to participate in a proseminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. degree candidate should satisfy the language requirement in two of these languages as early as possible. The department offers departmentally administered language examinations as an alternative to the ETS examinations.

For Seniors and Graduates

204. Geometry for Teachers. Metric and synthetic approaches to plane and solid geometry; affine geometry; an algebraic model of Euclidean geometry. 3 units. *Staff*

206. Introduction of Stochastic Processes. Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. 3 units. *Staff*

207, 208. Introduction to Algebraic Structures. Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants; finite dimensional inner product spaces. Prerequisites: Mathematics 104 for 207; and 207 for 208. 3 units per semester. *Warner*

217, 218. Intermediate Analysis. Elementary point set topology and differential calculus in n-space; implicit and inverse function theorems; integration theory; differentiable manifolds; differential forms; generalized Stokes' theorem. Prerequisite: Mathematics 104 for 217; and 217 for 218. 3 units per semester. *Staff*

221, 222. Numerical Analysis. See course description for Computer Science 221, 222. (Also listed as Computer Science 221, 222.) 3 units per semester. *Staff*

223. Numerical Analysis III. See course description for Computer Science 223. (Also listed as Computer Science 223.) 3 units. *Patrick*

***227, 228. Theory of Numbers.** Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisite: calculus. 3 units per semester. *Carlitz*

***229, 230. Algebraic Numbers.** Ideals, unique factorization, divisors of the

*Offered on demand.

discriminant, determination of the class number. Prerequisite: theory of equations. 3 units per semester. *Carlitz*

231. Applications of Graph Theory. Linear graphs, matrix representations, cycle structure, isomorphism, connectivity, independence, planarity, coloring, directed graphs, flows in networks as applied to engineering, management, computer science, urban systems, chemistry, physics, economics, sociology, psychology. 3 units. *Smith*

***234. Sample Designs.** Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multi-stage sampling; methods of estimation; questionnaire construction refusals and not-at-homes. Prerequisite: Mathematics 183. 3 units. *Staff*

235, 236. Algebra. Elementary categorical algebra; groups with operators, G-sets, structure of groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisites: Mathematics 208 or equivalent for 235; and 235 for 236. 3 units per semester. *Staff*

244. Analysis of Variance. Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe, Tukey, etc.), factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. 3 units. *Staff*

***245, 246. Combinatorial Analysis.** Generating functions, permutations, distributions, partitions, compositions, trees, and networks. Prerequisite: calculus. 3 units per semester. *Carlitz*

***247, 248. Arithmetic of Polynomials.** Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. *Carlitz*

256. Orientation for Applied Mathematics. Simulation and related notions; relation of science and technology with the evolution of mathematics; modern generalizations of the concepts of language, validity, empirical science, and statistical inference. Areas of application for various specific mathematical topics. Prerequisite: Mathematics 104. 3 units. *Murray*

260. Design of Experiments. Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. 3 units. *Burdick*

***262. Non-Parametric Statistics.** A study of statistical tests in which no assumption about the underlying distribution is made; one sample, two sample, k sample tests for nomial, ordinal and internal scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 244 or consent of the instructor. 3 units. *Staff*

265, 266. Homological Algebra and its Applications. Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: Mathematics 236 and 271 or consent of instructor. 3 units per semester. *Weisfeld*

269, 270. Recursive Function Theory. Basic properties, enumeration theorems, hierarchies, recursive function of higher types, generalized re-

*Offered on demand.

cursion theory; applications. Prerequisite: Mathematics 187 or consent of the instructor. 3 units per semester. *Shoenfield*

271, 272. Introductory Topology. Basic topological properties, including compactness, connectedness, and metrizability; product spaces and function spaces; introduction to algebraic topology. Prerequisites: Mathematics 104 for 271; and 271 for 272. 3 units per semester. *Staff*

273, 274. Algebraic Topology. Homology and cohomology theories; complexes; introduction to homotopy groups. Cech homology theory. Prerequisite: Mathematics 272. 3 units per semester. *Kraines*

275, 276. Probability. Foundations of probability; random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisites: Mathematics 135; or calculus, and consent of the instructor. 3 units per semester. *Staff*

284. Least-Squares Analysis of Linear Models. General linear models; geometrical interpretations; multiple regression; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models; analysis of covariance; introduction to non-linear models. Prerequisite: Mathematics 136. 3 units. *Burdick*

285. Applied Mathematical Methods I. The heat equation, the wave equation, separation of variables, Fourier series, introduction to Hilbert space, Fourier transform, potential theory; complex variables, residues. Prerequisite: Mathematics 104. 3 units per semester. *Reed*

286. Applied Mathematical Methods II. Eigenvalue problems, integral equations, the Fredholm alternative, bounded linear transformations on Hilbert space, applications to partial differential equations, techniques for approximating eigenvalues. Prerequisite: Mathematics 104. 3 units per semester. *Reed*

***287, 288. Foundations of Mathematics.** Propositional calculus, predicate calculus, axiomatized number theory. Godel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103 or consent of the instructor. (Also listed as Philosophy 287, 288.) 3 units per semester. *Shoenfield*

290. Stochastic Processes. Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. 3 units. *Staff*

291, 292. Analysis I, II. Theory of analytic functions, measure and integration theory, introduction to functional analysis. Prerequisite: Mathematics 218 or 140 or consent of the instructor. 3 units per semester. *Staff*

293. Multivariate Statistics. Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's T^2 statistic and the Roy union-intersection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284 or consent of the instructor. 3 units. *O'Fallon*

***295. Mathematical Foundations of Statistical Inference.** Inference-theoretic approach to hypothesis testing, decision-making, and estimation;

Neyman-Pearson fundamental lemma; uniformly most powerful test. Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275 or consent of the instructor. 3 units. *Staff*

297, 298. Axiomatic Set Theory. Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and their consequences. Prerequisite: consent of the instructor. 3 units per semester. *Shoenfield*

For Graduates

***303, 304. Advanced Theory of Numbers.** Cubic and quartic reciprocity, partitions and diophantine analysis, sums of squares. Prerequisite: Mathematics 288 or consent of instructor. 3 units per semester. *Carlitz*

325, 326. Analysis III, IV. Advanced topics in complex and real analysis, measure and integration theory, functional analysis. Prerequisite: Mathematics 292 for 325; and 325 for 326. 3 units per semester. *Murray*

***327, 328. Partial Differential Equations.** Boundary and initial value problems, regularity and existence theorems by methods of *a priori* estimates and functional analysis. Representations of solutions, spectral theory, and potential theory. Prerequisite: Mathematics 291-292 or consent of the instructor. 3 units per semester. *Staff*

***329, 330. Theory of Distributions.** Test functions, distributions, topological vector spaces, applications to the operational calculus, partial differential equations, and mathematical physics. 3 units per semester. *Staff*

***331, 332. Advanced Topics in Complex Variables.** Entire and meromorphic functions; harmonic functions and potential theory; Riemann surfaces; several complex variables. 3 units per semester. *Staff*

***333, 334. Analytic Theory of Numbers.** Distributions of primes, primes in an arithmetic progression. Waring and Goldbach problems, applications of elliptic functions. Prerequisite: Mathematics 291-292. 3 units per semester. *Carlitz*

***335, 336. Topics in Algebra.** Advanced topics in algebra to be selected from areas of current research. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. *Staff*

***343, 344. Differential Equations.** Manifolds, sheaves, differential operators and their prolongations, Spencer sequences, δ-cohomology, existence theorems for analytic partial differential equations, the δ-estimate, D-Neumann problem. Prerequisites: Mathematics 236, 272, and 292, or consent of the instructor. 3 units per semester. *Staff*

***353, 354. Topics in Analysis.** Advanced topics in real and complex analysis to be selected from areas of current research. Prerequisite: Mathematics 325, which may be taken concurrently. 3 units per semester. *Staff*

361, 362. Hilbert Space. Spectral theory for Hermitian and unitary transformations; maximal symmetric transformations; canonical resolution of closed transformations; singular integral equations; the Weyl circle; indices for differential operators; deficiency characteristics of closed transformations; topologies for bounded transformations; von Neumann alge-

*Offered on demand.

bras; resolution theory; Abelian and factor rings. Prerequisites: Mathematics 236 and 292, or consent of instructor. 3 units per semester. *Murray*

***371, 372. Dimension Theory.** Theory of covers in normal spaces; inductive and covering dimension of metric spaces and of normal spaces; dimension of Euclidean spaces, mapping in spheres and applications; metric dimension and other metric-dependent functions. Prerequisites: Mathematics 271-272. 3 units per semester. *Hodel*

375. Advanced Point Set Topology. Advanced topics in point set topology to be selected from areas of current research. 3 units per semester. *Hodel*

***377, 378. Topics in Topology.** Advanced topics in topology to be selected from areas of current research. 3 units per semester. *Staff*

***383, 384. Lie Groups and Algebras.** Differential manifolds; Lie groups; one-parameter subgroups; Lie algebras; differential forms; classification and representations of compact Lie groups and semisimple Lie algebras; solvable and nilpotent algebras; Ado's theorem. Prerequisites: Mathematics 236, 271 and either Mathematics 218 or 291. 3 units per semester. *Shoenfield*

***392. Nuclear Spaces.** The theory of nuclear locally convex spaces, as developed by Grothendieck and Pietsch; applications to spaces of distributions. Prerequisite: Mathematics 292. 3 units. *Moore*

***393. Topological Groups.** Elementary theory; Haar measure; compact groups; locally compact Abelian groups; duality theory. Prerequisites: Mathematics 236 and 272, or consent of instructor. 3 units. *Warner*

***394. Topological Rings.** Compact, locally compact, and linearly compact rings. Prerequisite: Mathematics 393 or consent of instructor. 3 units. *Warner*

***395, 396. Topological Algebra.** Normed and locally convex spaces. Banach algebras. Prerequisites: Mathematics 236 and 292, or consent of the instructor. 3 units per semester. *Moore*

***397, 398. Seminar in Algebra and Number Theory.** Prerequisite: consent of the instructor. 3 units per semester. *Carlitz*

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. For a description of the program see p. 24; for a description of individual courses see listings under the specified department.

DEPARTMENT OF ART

233. Early Medieval Architecture. *Sunderland*

234. Romanesque Sculpture. *Sunderland*

237. French Renaissance Art. *Jenkins*

245, 246. Problems in Italian Renaissance Painting. *Staff*

248. Florentine Painting during the Renaissance. *Covi*

253. Studies in Italian Renaissance Sculpture. *Covi*

*Offered on demand.

255, 256. Iconological Problems. *Langedijk*

DEPARTMENT OF CLASSICAL STUDIES

Latin

221. Medieval Latin I. *Newton*

222. Medieval Latin II. *Newton*

225. Palaeography. *Newton*

305. Latin Seminar V. Prerequisite: consent of instructor. *Newton*

306. Latin Seminar VI. Prerequisite: consent of instructor. *Newton*

312. Proseminar in Latin Palaeography. *Newton*

Classical Studies

327. Seminar in Byzantine History. *Rigsby*

DEPARTMENT OF ENGLISH

207, 208. History of the English Language. *Nygard and Reiss*

210. Old English Literary Tradition. *Nygard and Reiss*

212. Middle English Literary Tradition. *Nygard and Reiss*

215, 216. Chaucer. *Nygard and Reiss*

221. English Prose of the Sixteenth Century.

222. English Nondramatic Poetry of the Sixteenth Century. *DeNeef*

223. Spenser. *DeNeef*

224. Shakespeare. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. *Randall*

229. English Literature of the Seventeenth Century. *Randall and Williams*

232. Milton.

310. Beowulf. *Nygard*

312. Studies in Middle English Literature. *Nygard and Reiss*

315. Studies in Chaucer. *Nygard and Reiss*

318. Medieval Romances. *Reiss*

320. Studies in Renaissance English Prose.

324. Studies in Shakespeare. *Williams*

325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. *Randall*

329. Studies in the Metaphysical Poets. *Williams*

383. Textual Criticism. *Williams*

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

205, 206. Middle High German. *Staff*

215. Seventeenth Century Literature. *Borchardt*

216. History of the German Language. *Staff*

217. Renaissance and Reformation Literature. *Borchardt*

DEPARTMENT OF HISTORY

221. Problems in the Economic and Social History of Europe, 1200-1700. *Witt*

222. Problems in European Intellectual History, 1250-1550. *Witt*

237. Europe in the Early Middle Ages. *Young*

238. Europe in the High Middle Ages. *Young*

267-268. From Medieval to Early Modern England. *Ferguson*

351.10-352.10. Medieval Europe. *Young*

351.15-352.15. The English Renaissance. *Ferguson*

DEPARTMENT OF PHILOSOPHY

218. Medieval Philosophy. *Mahoney*

DEPARTMENT OF RELIGION

236. Luther and the Reformation in Germany. *Steinmetz*

241. Problems in Reformation Theology. *Steinmetz*

251. The Counter-Reformation and the Development of Catholic Dogma. *Raitt*

334. Theology and Reform in the Later Middle Ages. *Steinmetz*

336. Christian Mysticism in the Middle Ages. *Raitt*

338. Calvin and the Reformation in Switzerland. *Steinmetz*

339. The Radical Reformation. *Steinmetz*

344. Zwingli and the Origins of Reformed Theology. *Steinmetz*

DEPARTMENT OF ROMANCE LANGUAGES

French

213, 214. French Literature of the Seventeenth Century. *Staff*

219. Old French Literature. *Vincent*

224. History of the French Language. *Hull*

225. French Prose of the Sixteenth Century. *Tetel*

226. French Poetry of the Sixteenth Century. *Tetel*

311, 312. French Seminar (Medieval and Renaissance Topics). *Tetel and Vincent*

Italian

284. Dante. *Fowlie*

288. The Renaissance. *Tetel*

251. The Origins of Spanish Prose Fiction. *Wardropper*

252S. Spanish Lyric Poetry before 1700. *Wardropper*

253. The Origin of the Spanish Theater. *Wardropper*

257. Old Spanish. *Davis*

258. Medieval Literature. *Davis or Garci-Gómez*

265. Cervantes. *Predmore or Wardropper*

266. Drama of the Golden Age. *Wardropper*

321, 322. Hispanic Seminar (Medieval and Renaissance Topics). *Garci-Gómez, Predmore, or Wardropper*

Microbiology and Immunology

Professor Joklik, *Chairman* (Research Park IV); Professor Willett, *Director of Graduate Studies* (111 Research Park IV); Professors Amos, Burns, Day, Metzgar, Osterhout, and Wheat; Associate Professors C. Buckley III, R. Buckley, Nichols, Rosse, Seigler, Smith, Vanaman, Ward, and Zweerink; Assistant Professors Bolognesi, Cresswell, Dawson, Lang, Lauf, Levy, Scott, and Snyderman

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

212, 213. Research Techniques in Microbiology and Immunology. An introduction to biochemical, immunological, and cell culture techniques with emphasis on approaches to contemporary problems in molecular and cellular biology. Prerequisites: Biochemistry 247 or equivalent, and consent of instructor. Offered only in the summer. 2 units. *Dawson, Vanaman, or Staff*

219. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Pathology 219, and Physiology 230.) 3 units. *Counce or Staff*

219S. Seminar. Optional seminar offered in conjunction with Microbiology 219.

221. Medical Microbiology. An intensive study of the common bacteria, viruses, fungi, and parasites which cause disease in man. The didactic portion of the course focuses on the nature and biological properties of microorganisms causing disease, the manner of their multiplication, and their interaction with the entire host as well as specific organs and cells. 4 units. *Joklik or Staff*

233. Microbiology. Introduction to bacteriology, virology, cell biology and immunology. Structure, metabolism and growth of bacteria, the properties of bacterial and animal viruses, and basic immunology. (Also listed as Botany 233.) 3 units. *Willett, Burns, Joklik, or Amos*

242. Mechanisms of Microbial Pathogenicity. A lecture-seminar course on the principles and problems of host-parasite interactions at the cellular and molecular level. Emphasis will be on the roles of microbial structures and products in the virulence and pathogenesis of acute, chronic, and toxigenic infectious disease systems. Prerequisites: Biochemistry 247 and Microbiology 233 or equivalent. 2 units. *Wheat*

252. General Animal Virology and Viral Oncology. The first half of the course will be devoted to a discussion of the structure and replication of mammalian viruses with special emphasis on the molecular and functional aspects. A second part of the course will deal specifically with tumor viruses, which will be discussed in terms of the virus-cell interaction and the response to the host. The relationship of virus infection to neoplasia will be emphasized. 4 units. *Joklik, Smith, Zweerink, or Nichols*

282. Molecular Microbiology. A study of the structure, growth, and replication of bacteria with a detailed analysis of the synthesis and regulation of the structural, informational, and catalytic macromolecules. Major topics covered include: structure, function, and synthesis of bacterial integuments, DNA, RNA, and protein; genetic and metabolic regulatory mechanisms; primitive differentiation in procaryotes. Prerequisite: general biochemistry. 4 units. *Burns, Nichols, or Vanaman*

291. Basic Immunology. Structure and function of immunoglobulins. Characteristics of synthetic and natural antigens. Specificity and cross-reactivity. Methods of immunologic analysis. Cellular aspects and kinetics of antibody formation. Forms of immunologic responsiveness and unresponsiveness. Cellular cooperation. Elicitation and control of immune responses. 3 units. *Scott, Dawson, Snyderman, or Amos*

296. Immunochemistry. The primary and conformational structures of the immunoglobulins—chains, regions, sizes, allotypes, evolution. The antibody binding site—location, specificity, subgroups, idiotypes, antigen accommodation. The reaction of antibodies—affinity and the law of mass action, homogeneous binding, kinetics, virus model, precipitation reactions, active centers of multivalent antigens, conformational determinants. Affinity, the immune responses, and clonal selection. 3 units. *Day*

For Graduates

313. Immunohematology. A lecture course covering historical and current concepts of blood cell antigens and antibody. Emphasis will be placed on the genetics, serology, chemistry, and anthropological aspects of human red cell isoantigens and antibodies. White cell and platelet antigens, the hematological consequences of immunological reactions involving the cellular elements of the blood, and comparative blood group antigens in other species will also be considered. 2 units. *Rosse*

323. Readings in Bacteriology and Immunology. A course of readings and syntheses in restricted areas of bacteriology and immunology under the direction of individual staff members. 2 units.

325. Medical Mycology. This course is intended to familiarize the graduate student majoring in mycology with the fungi causing disease in man and animal. The course includes practical laboratory work with materials from patients in Duke Hospital and those sent to the Duke Fungus Registry from outside sources. Prerequisites: a master's degree in botany with major

in mycology and Microbiology 221. Maximum registration: four students. 4 units.

330. Medical Immunology. A course designed to present the basic concepts of immunology as they relate to human disease. Emphasis will be on tumor immunology, autoimmunity, neuroimmunology, immunohematology, and immunologic deficiency diseases. 6 units. *Levy or Staff*

331.1-331.8. Microbiology Seminar. Current topics in microbiology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in microbiology. 1 unit per semester. *Staff*

332.1-332.8. Immunology Seminar. Current topics in immunology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in immunology. 1 unit per semester. *Staff*

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Tests for histocompatibility including lymphocyte interactions and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed under the University Program in Genetics.) 2 units. *Amos or Ward*

420. Cellular Immunophysiology. See course description for Physiology 420. (Also listed as Physiology 420.) 2 units. *Lauf or Staff*

Pathology

Professor Kinney, *Chairman* (301B Medical School); Professor Sommer, *Director of Graduate Studies* (301 Medical School); Professors Fetter, Hackel, Johnston, Klintworth, Vogel, Pratt, and Wittels; Associate Professors Elchlepp, Bradford, and Ratliff; Assistant Professors Adams, Anderson, Bigner, Bossen, Daniels, Graham, Hawkins, Jauregui, Shelburne, Tisher, Wilson, and Zwadyk

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of speciality and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

219. Molecular and Cellular Basis of Development. For a description of the course see Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Microbiology 219, and Physiology 230.) 3 units. *Counce, McCarty, or Staff*

219S. Seminar. Optional seminar offered in conjunction with Pathology 219.

250. General Pathology. The fundamentals of pathology are presented to the student. Lectures developing broad concepts of disease processes are given by the members of the senior staff. The emphasis is placed on etiology and pathogenesis of disease. Lecture. Prerequisites: histology and permission of instructor. 4 units. *Kinney or Staff*

251. Laboratory Course in General Pathology. Laboratory session to com-

plement 250. Gross and microscopic material is correlated with and related to disease processes. Pathology 250 may be taken concurrently. Prerequisites: histology and permission of instructor. 4 units. *Kinney or Staff*

258. Cellular and Subcellular Pathology. This course is designed for students wishing to broaden their knowledge of cellular structure and cellular pathology. The course consists of lectures and seminars discussing the alterations in cellular structure and associated functions that accompany cell injury. Prerequisite: permission of instructor. Fall only. Time to be arranged. 3 units. *Hawkins, Shelburne, or Sommer*

275. Fundamentals of Electron Microscopy. Theoretical basis of practical electron microscopy. Areas to be discussed include the nature of light and electrons, light and electron optics, image recording and processing by photographic and other methods, specimen preparation, functional anatomy of the electron microscope, and several special techniques. Student presentations and selection of special topics will be encouraged. The approach will be non-mathematical, but college physics is strongly recommended. Practical laboratory experience will be included. Spring and fall, 1975. Fall only thereafter. 2 units. Time to be arranged. *Hawkins, Shelburne, or Sommer*

325. Cardiovascular Pathology. Cardiovascular disease processes will be studied, reviewing anatomic, embryologic, and physiologic features, and utilizing case material and gross and microscopic specimens. Consideration will be given to principles of electrocardiography. Fall only. 3 units. *Hackel or Ratliff*

352. Basic Problems in Chemical Pathology. This is an advanced seminar tutorial course in which the biochemical and physiological expressions of morphologic abnormalities will be explored. Specific organ systems will be used as a model for instruction and discussion. Experimental approaches toward solutions of problems will be discussed. Prerequisite: permission of instructor. 2 units. *Wittels*

353. Advanced Neuropathology. This course deals with current problems and research methods related to diseases which affect the nervous system. Prerequisite: permission of instructor. Fall only. 2 units. *Vogel*

355, 356. Graduate Seminar in Pathology. Discussions outlining the scope of modern pathology. This will include reports of original researchers by members of staff and visitors. Time to be arranged. 1 unit each semester. *Sommer or Staff*

357. Research in Pathology. Independent research projects in various fields of pathology. Time and credit to be arranged. *Kinney or Staff*

360. Histochemistry. Theory and application of histochemical techniques for investigating the presence of proteins, lipids, carbohydrates, and enzymes at the light and/or electron microscopic level. A quantitative identification of nucleoproteins by cytophotometric and autoradiographic techniques will be given special consideration. Students will be encouraged to develop a small project of their choice. Spring only. 3 units. *Hawkins, Shelburne, or Sommer*

361, 362. Autopsy Pathology. A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Emphasis is on individual work in the laboratory with tutorial supervision. Gross dissection, histologic examination, processing, and analyzing of morphologic,

microbiologic, and biochemical data, and interpretation of results. Prerequisites: Pathology 250 and permission of instructor. 3-6 units per semester. *Kinney or Staff*

364. Systemic Pathology. Systematic presentation of the characteristics of disease processes as they affect specific organ systems in mammals. 6 units. *Hackel or Staff*

367, 368. Special Topics in Pathology. Special problems in pathology will be studied with a member of the senior staff; the subject matter will be individually arranged. Time to be arranged. 4 units. *Kinney and Staff*

369. Ophthalmic Pathology. This course will consist of lectures, seminars, and laboratory sessions. The normal anatomy and embryology of the eye will be reviewed as a basis for the study of the various ocular disease processes. The more common diseases of the eye will be considered in detail. Problems in ophthalmic pathology will be discussed together with methods of solving them. Fall only. 3 units. *Klintworth*

370. Developmental Pathology and Teratology. A systematic study of disease processes involving the prenatal, natal, and postnatal period. Emphasis will be placed on developmental anatomy and teratogenesis. The format includes seminars and clinicopathologic correlations derived from gross and microscopic material. Prerequisites: Pathology 350, anatomy, and histology. Fall only. 3 units. *Bradford or Wilson*

373. Cytopathology. This course is designed to present the principles and techniques by which basic cytology is applied to the diagnostic interpretation of disease. Classroom and laboratory work will include diseases involving the female genital tract, respiratory tract, urinary tract, effusions, gastrointestinal tract, and central nervous system. Neoplastic disease will be emphasized. Practical application of the acquired knowledge will be made in examining current material. Prerequisites: Pathology 350, 351, or permission of instructor. Fall. 3 units. *Johnston or Staff*

374. Pulmonary Pathology and Postmortem Pathophysiology. Emphasis will be on pulmonary pathology and pathophysiology of infectious, metabolic, environmental, and neoplastic diseases, and certain diseases of unknown etiology (e.g., sarcoid, alveolar proteinosis, etc.). Ventilatory experiments will be done on excised human lungs. Fall. 3 units. *Pratt*

377. Pathology of the Kidney. The course includes a comprehensive study of pathological, immunological, and clinical features of the glomerulonephritides, the nephrotic syndrome, and pyelonephritis, as well as of metabolic, congenital, and neoplastic renal disorders. Lectures will be supplemented with gross and microscopic specimens, demonstrations, and special library studies. Fall. 3 units. *Tisher*

378. Immunopathology. A study of human diseases in which the immune system plays an important role. A series of lectures, seminars, and studies of human case materials. Fall. 4 units. *Daniels, Bigner, Adams, or Bossen*

379. Pathology of Virus Infections. The pathological effects of viruses will be discussed. A series of lectures and student-conducted seminars concerning the structural, biochemical, and functional alterations associated with virus-cell interactions. Spring. 4 units. *Daniels or Bigner*

Philosophy

Professor Welsh, *Chairman* (201K West Duke Building); Professor Peach, *Director of Graduate Studies* (201E West Duke Building); Professor Negley; Associate Professors Mahoney, Roberts, and Sanford; Assistant Professors Benditt and Ross; Visiting Associate Professor Rachels; Visiting Assistant Professor Bamford

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophical analysis, ethics, aesthetics, political philosophy, and philosophy of law.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take one or two qualifying examinations, diagnostic in purpose. One examination tests his ability to deal critically and systematically with some basic philosophical topic; a second examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

For Seniors and Graduates

202. Aesthetics: The Philosophy of Art. A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music, and painting. Problems discussed include the role of standards in criticism, aesthetic judgment, interpretation, and evaluation in literature, meaning in the arts, art and truth, the arts and morality. 3 units. *Welsh*

203. Contemporary Ethical Theories. Study of the nature and justification of basic ethical concepts and principles in the light of the chief ethical theories of twentieth century British and American philosophers. 3 units. *Benditt*

204. Philosophy of Law. Natural law theory and positivism; the idea of obligation: legal, political, social, moral; and the relation of law and morality. 3 units. *Benditt*

205. Philosophy of History. The nature of historical knowledge and inquiry and theories of the historical process. 3 units.

206. Topics in Ethical Theory. 3 units. *Benditt*

208. Political Values. Analysis of the systematic justification of political principles and the status of political values in the administration of law. 3 units. *Negley*

211. Plato. A critical study of selected dialogues with special emphasis on problems in epistemology and metaphysics. 3 units. *Mahoney*

217. Aristotle. A study of passages from the *Organon*, *Physics*, *De Anima*, and *Metaphysics*. 3 units. *Mahoney*

218. Medieval Philosophy. A critical examination of selected problems in medieval philosophy. 3 units. *Mahoney*

225. British Empiricism. A critical study of the writings of Locke, Berkeley, or Hume, with special emphasis on problems in the theory of knowledge. 3 units. *Peach*

227. Continental Rationalism. A critical study of the writings of Descartes, Spinoza, or Leibniz, with special emphasis on problems in the theory of knowledge and metaphysics. 3 units. *Peach or Roberts*

228. Recent and Contemporary Philosophy. A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore, Russell, Wittgenstein, Wisdom, and Ryle. 3 units. *Welsh*

230. The Meaning of Religious Language. See course description for Religion 230. (Also listed as Religion 230.) 3 units. *Poteat*

231. Kant's Critique of Pure Reason. 3 units. *Bamford*

232. Recent and Continental Philosophy. Selected topics. 3 units.

233. Methodology of the Empirical Sciences. Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and observation, probability and induction, and other topics. Prerequisite: consent of instructor for students from other departments. 3 units. *Ross*

234. Problems in the Philosophy of Science. Selected problems in the physical and nonphysical sciences such as space and time, measurement, and determination in science. Prerequisite: consent of instructor for graduate students from other departments. 3 units. *Ross*

241. Symbolic Logic. Detailed analysis of deduction and of deductive systems. 3 units.

251. Epistemology. Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. 3 units. *Sanford*

252. Metaphysics. Selected topics in metaphysics, e.g., substance, qualities and universals, identity, space, time, causation, and determinism. 3 units. *Sanford*

253. Philosophy of Mind. An analysis of concepts such as thought and belief; and such issues as mind-body relations, thought and action; the nature of persons and personal identity. 3 units.

254. Philosophy of Religion. Topics such as proofs of the existence of God, meaningfulness of religious language, the problem of evil, and immortality and resurrection. 3 units. *Roberts*

255. Philosophy of Action. Problems in the individuation, characterization, and explanation of human actions; analysis of such concepts as choosing, deciding, intending, doing, making, and letting. 3 units.

260. Wittgenstein. An examination of the *Tractatus* or the *Investigations*. 3 units. *Welsh*

287, 288. Foundations of Mathematics. See description for Mathematics 287, 288. (Also listed as Mathematics 287, 288.) 3 units per semester. *Henson*

291, 292. Seminar in Special Fields of Philosophy. 3 units. *Graduate Staff*

For Graduates

331, 332. Seminar in Special Fields of Philosophy. 3 units. *Graduate Staff*

Physical Therapy

Associate Professor Branch, *Acting Co-Chairman and Director of Graduate Studies* (045 Hospital); Associate Professor Villanueva

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and statistics. In the first year of the curriculum students are required to take courses in anatomy and physiology, offered by those respective departments. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3965, Duke University Medical Center.

201, 202. Seminar in Physical Therapy. Historical background and trends in the profession; orientation to physical therapy departmental organization and administration; professional and community relationships; professional ethics; methods of communication; and literature review. Units by arrangement. *Villanueva and Staff*

217. Physical Therapy Dynamics I. Orientation to patient care; principles of biomechanics and applied anatomy; introduction to microscopic anatomy. 3 to 4 units. *Branch, Villanueva, or Staff*

218. Physical Therapy Dynamics II. Regional approach to the process of human movement analysis, including kinesiological analysis of normal and pathological patterns of gait; introduction to therapeutic exercise, with emphasis on rationale and methods of treatment; principles and practice of physical therapy procedures, with emphasis on biophysical and physiological considerations for utilization of selected therapeutic agents: mechanical, thermal, chemical, and electrical. 5 units. *Branch, Villanueva, or Staff*

220. Physical Therapy Dynamics III. The role of the central nervous system in the inhibition or facilitation of motor behavior as related to the management of patients with central nervous system disorders. Emphasis on the application of current neurophysiological concepts to the evaluation of patients with central nervous system deficits and to the planning and administration of treatment programs. 2 to 4 units. *Villanueva or Staff*

230. Physical Evaluation and Instrumentation. Principles and techniques of objective assessment and analysis of functional status, including manual muscle tests, dynamometry, goniometry, electrical diagnostic testing, pos-

ture analysis, body measurements, evaluation of respiratory and sensory function, disability evaluation, and orientation to electromyography and nerve conduction studies. 3 units. *Staff*

234. Introductory Pathology. Fundamentals of pathology with emphasis on broad concepts of disease processes; systems of the body are studied from the point of view of histological and functional change. 3 units. *Branch and Special Lecturers*

236. Medical Sciences. Lectures by clinicians with patient demonstrations and correlation of treatment methods; medical and surgical, neurological, orthopaedic, and emotional conditions affecting human dysfunction; emphasis on psychodynamic principles of patient-therapist relationships. 4 units. *Staff and Special Lecturers*

238. Introduction to Health Service Systems. Political, economic, and sociocultural aspects of the organization of health care systems; structural components and interrelationships; criteria for assessing and analyzing health care systems. 2 to 3 units. *Staff*

242. Directed Clinical Experience in Physical Therapy I. Students are assigned to hospitals, rehabilitation centers, schools for crippled children, extended-care facilities, and public health units for short-term supervised learning experiences. 1 to 2 units. *Staff*

243. Directed Clinical Experience in Physical Therapy II. Students are assigned to full-time learning experiences under direction. 2 to 4 units. *Staff*

301. Introduction to Scientific Inquiry. Theory and use of analytical methods of problem-solving; elements of scientific writing; preparation of a research protocol and a major paper. 3 units. *Staff*

315. Curriculum Development. Introduction to learning theory; development of objectives, organization, course content, and evaluation in physical therapy education. 2 to 3 units. *Staff*

316. Directed Teaching in Physical Therapy. 1 to 3 units. *Staff*

320. Sensorimotor Mechanisms Related to Rehabilitation. Development of normal motor behavior, and structural and functional organization of the nervous system related to methods of facilitating functional capacities for performing the activities of daily living. 2 to 3 units. *Villanueva or Staff*

322. Case Conferences in Rehabilitation. Observation and demonstration of care of patients with extensive disability; emphasis on integration of health services for comprehensive care via the case conference approach. 1 to 2 units. *Staff*

332. Administration of Physical Therapy Services. Principles of administration, leadership styles, and management roles; concepts of systems theory and analysis; planning, organizing, delivering, and evaluating physical therapy systems and subsystems. 3 units. *Staff*

341-342. Advanced Seminar—Selected Problems. 2 to 3 units. *Staff*

350. Research. Units by arrangement. *Staff*

Physics

Professor Newson, *Chairman* (119 Physics Building); Associate Professor Evans, *Director of Graduate Studies* (111 Physics Building); Professors Bieden-

harn, Bilpuch, Fairbank, Gordy, Greuling, Lewis, Meyer, Roberson, Robinson, Walker, and Walter; Adjunct Professors Robl and Way; Associate Professors Cusson, Fortney, Han, and Riedel; Assistant Professor DeLucia, Golner, Goshaw, Lawson, Lisowski, and Loos

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to fit his needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. degree. The option of taking the A.M. without thesis is available with the approval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, or Russian, is required for the Ph.D. degree.

For Seniors and Graduates

211, 212. Advanced Modern Physics. Quantum theory with applications to the study of atoms, molecules, solids, and nuclei. Prerequisites: Physics 161, 181, or equivalents; Mathematics 285-286 or equivalent, may be taken concurrently. 3 units per semester. *Robinson*

215. Introduction to Quantum Mechanics. Wave mechanics and elementary applications; the hydrogen-like atoms; electron spin and angular momentum; operators and eigenvalues; stationary state perturbation theory; identical particles. Prerequisites: courses in modern physics and intermediate mechanics; Mathematics 285-286 may be taken concurrently. 3 units. *Evans*

217, 218. Advanced Physics Laboratory and Seminar. Measurements involving the fields of mechanics, electricity, magnetism, heat, sound, optics, and modern physics. 3 units per semester. *Meyer*

220. Electronics. Basic elements of modern electronics including a.c. circuits, transfer functions, solid state service, transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. 3 units. *Fortney*

223. Electricity and Magnetism. Electrostatic fields and potentials, boundary value problems, magnetic fields and potentials, magnetic induction, energy in electromagnetic fields. Maxwell's equations, introduction to electromagnetic radiation. 3 units. *Loos*

282. Mechanics of Continuous Media. Small vibrations, rigid body motion, hydrodynamics, elasticity. Prerequisites: Physics 41-42 or 51-52 and differential and integral calculus. 3 units. *Walker*

For Graduates

302. Advanced Mechanics. The fundamental principles of Newtonian mechanics; general dynamics of systems of particles and rigid bodies; the methods of Lagrange and Hamilton; generalized mechanics. 3 units. *Cusson*

303. Statistical Mechanics. Fundamental laws of thermodynamics and statistical mechanics with applications to physics and chemistry. Classical and quantum ideal gases; approximate methods for real gases and liquids. Prerequisite: Physics 215. 3 units. *Golner*

*304. **Advanced Topics in Statistical Mechanics.** This course will vary from year to year. Possible topics include Fermi liquids, systems of bosons, many-body theory, non-equilibrium statistical mechanics. Prerequisites: Physics 303 and 316. 3 units. *Riedel*

305. Introduction to Nuclear Physics. Phenomenological aspects of nuclear physics; interaction of gamma radiation and charged particles with matter; nuclear detectors; particle accelerators; radioactivity; basic properties of nuclei; nuclear systematics; nuclear reactions, particle scattering; nuclear models of the deuteron; nuclear forces; parity. 3 units. *Roberson*

*306. **Low Temperature Physics.** The properties of matter near the absolute zero of temperature; superconductivity, liquid helium, adiabatic demagnetization. Prerequisite: Physics 303. 3 units. *Fairbank*

308. Introduction to High Energy Physics. High energy processes; electromagnetic, weak, and strong interactions. 3 units. *Walker*

309. Solid State Physics I. Properties of matter in the condensed state; crystal lattices, electrons in metals and semiconductors, band theory, nonmetallic solids, lattice dynamics, and phonons. Prerequisites: Physics 215 and 303. 3 units. *Riedel*

*310. **Solid State Physics II.** Elementary excitations and their interactions in the condensed state of matter; scattering theory and correlation functions; magnetic interactions in solids, superconductivity; amorphous solids. Prerequisites: Physics 309 and 316. 3 units. *Riedel*

312. Phase Transitions and Critical Phenomena. Description of phase transitions in diverse physical systems such as fluids, magnets, mixtures, and superfluids. Experimental techniques and results. Application of the classical methods of thermodynamics, correlation functions, and mean field theory to the critical state of matter. Microscopic models of phase transitions. Modern approaches to static and dynamic critical phenomena such as the theories of critical exponents, scaling, series expansions, critical relaxation, and mode-mode coupling. 3 units. *Riedel*

316. Principles of Quantum Theory. Original and fundamental concepts of quantum theory; wave and matrix mechanics; theory of measurements; exclusion principle and electronic spin. Prerequisite: Physics 302. 3 units. *Evans*

317. Intermediate Quantum Theory. General operator methods; angular momentum; Dirac electron theory. Second quantization; symmetry principles and conservation theorems. Applications to the theory of solids, of nuclei, and of elementary particles will be stressed. Prerequisite: Physics 316. 3 units. *Biedenharn*

318. Electromagnetic Field Theory. Electrodynamics; theory of wave optics; radiation of electric and magnetic multipole fields; special relativity; covariant electrodynamics; Lienard-Wiechert potentials; scattering and dispersion; Hamiltonian field equations. Prerequisite: Physics 223. 3 units per semester. *Greuling*

*330. **Nuclear Structure Theory.** Two body nuclear forces used to describe nuclear structure; nuclear shell and collective models; properties of nuclear levels; magnetic and quadrupole moments; transition probabilities; nucleon-nucleon scattering; nuclear reactions. Prerequisites: Physics 305 and 316. 3 units.

*Offered on demand.

*331. **Microwave Radiation.** Microwave generators, cavity resonators, transmission lines, radiation propagation, and detection. 3 units. *Gordy*

*335. **Microwave Spectroscopy.** Application of microwaves in the determination of molecular, atomic, and nuclear properties. Stark and Zeeman effects in microwave spectroscopy. Magnetic resonance absorption. 3 units. *Gordy*

*341. **Advanced Topics in Quantum Theory.** Introduction to relativistic quantum field theory; Lorentz and Poincaré groups; quantization of free fields; interacting fields and S-matrix; applications to quantum electrodynamics and dispersion relations. Prerequisite: Physics 317. 3 units. *Han*

*342. **Theory of Elementary Particles.** Theoretical methods used in treating particle interactions, emphasizing phenomenological treatments. Quantum field theory and dispersion theory is developed as needed. Applications in the general areas of pion physics, electromagnetic interactions of hadrons, strange particle interactions, and weak interactions are surveyed. Prerequisite: Physics 316. 3 units. *Han*

*343. **Nuclear Physics.** Elementary theory of the deuteron; low energy neutron-proton scattering; theory of nuclear reactions; penetration of potential barriers; nuclear energy levels. Prerequisite: Physics 215. 3 units. *Newson*

*344. **Advanced Nuclear Physics.** The deuteron, nuclear forces, scattering of elementary particles, beta-radiation. Other aspects of nuclear physics amenable to theoretical interpretation. 3 units. *Biedenharn*

*345. **High Energy Physics.** Experimental and theoretical aspects of high energy nuclear processes; properties of mesons and hyperons. 3 units.

*346. **Topics in Theoretical Physics.** The content of this course will vary from year to year. General methods in quantum mechanics such as group theory and its applications; elementary particle theory; field theory; theory of solids; theoretical nuclear physics; atomic and molecular structure. Prerequisites: Physics 316, 317. 3 units.

351, 352. **Seminar.** A series of weekly discussions on topics related to the research projects under investigation in the department. 2-4 units. *Graduate Staff*

397, 398. **Low Temperature and Solid State Seminar.** Weekly seminar on advanced topics and recent research work in the field of low temperature and solid state physics. 2-4 units. *Riedel*

Physiology and Pharmacology

Professor Tosteson, *Chairman* (388 Medical Sciences I); Professor Narahashi, *Vice Chairman* (436 Medical Sciences I); Associate Professor Ottolenghi, *Director of Graduate Studies* (425 Medical Sciences I); Professors Bernheim, Blum, Hitchings, Jobsis, Johnson, Lack, Maxwell, Moore, Nichol, Schanberg, and Somjen; Associate Professors Anderson, Fellows, Kylstra, Lauf, Lieberman, McManus, Mendell, Menzel, Mills, Padilla, Salzano, and Wolbarsht; Assistant Professors Carter, Elford, Greenfield, Gunn, Gutknecht, Kirk, Kootsey, Lebovitz, Mandel, Namm, Rosen, Rosenthal, Schomberg, Schooler, Slotkin, Wachtel, and Wallace

*Offered on demand.

The Department of Physiology and Pharmacology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, or engineering. There is no foreign language requirement. All graduate students are required to take the introductory courses in both physiology and pharmacology. A brochure which describes the program of study, facilities, and research activities of the staff is available from the Director of Graduate Studies.

For Seniors and Graduates

200. Introduction to the Physiology of Man. Lectures and conferences on cell and organ physiology. Human and medical aspects are stressed in clinical conferences and in laboratory experience. The neurophysiology section is given in a three-week period following the end of the semester. Limited to students whose training requires knowledge of human physiology as it pertains to medicine. Three lectures, two conferences and one laboratory per week. Prerequisites: permission of the course leader. Fall. 7 units. *Jöbsis and Staff*

202. Introduction to Physiology. The lectures are the same as those in Physiology 200, but the conference is separate without the emphasis on human or medical aspects. The neurophysiology unit of Physiology 200 given in a three-week period following the end of the semester is required of all registrants. Designed for graduate students. Three lectures and one conference per week. Prerequisite: permission of course leader. Fall. 5 units. *Jöbsis and Staff*

203. Advanced Physiology. Material presented demonstrates in greater depth and detail than Physiology 202, the experimental basis and theoretical framework of contemporary physiological thinking. Controversial problems are introduced and recent literature discussed. Designed for graduate students. Must be taken with Physiology 202 unless the student has already had an equivalent course approved by the course leader. Two lectures, one conference, and one laboratory per week. Prerequisite: undergraduates—permission of the course leader. Fall. 4 units. *Somjen and Staff*

208. Respiratory System in Health and Disease. Primary emphasis on the physiology of respiration. Topics include pulmonary mechanics, gas exchange, ventilation-perfusion relationships, central and peripheral regulation of ventilation and respiratory responses to exercise, altitude, and hyperbaric environments. Spring. 2 units. *Salzano and Kylstra*

210, 211. Individual Study and Research. Directed reading and research in physiology and pharmacology. Prerequisites: senior standing and permission of the Director of Graduate Studies. Fall and spring. 3 to 9 units per semester. *Staff*

212. Membrane Physiology and Osmoregulation. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in aquatic plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport and metabolism in crustaceans, and application of radiotracer and other physical and chemcial techniques to the study of membrane function. Prerequisite: permission of instructor. Summer. 6 units. *Gutknecht and Staff*

215. Topics in Developmental Physiology. The physiological basis of development at the organ level with special reference to vertebrates. Development of neuronal connections, cardiogenesis, hormonal regulation and cellular interactions in organogenesis. Prerequisite: permission of instructor. Alternate years beginning spring, 1977. 2 units. *Mendell, Lieberman, or Padilla*

216. Contractile Processes. Cellular basis of activity in cilia and skeletal, cardiac, and smooth muscle; submicroscopic structure and behavior of muscle; special properties of muscle membranes; the problem of electro-mechanical coupling; mechanics, thermodynamics, and biochemistry of muscular contraction; developmental and adaptive changes in function. Prerequisite: permission of instructor. Alternate years beginning fall, 1976. (Listed also as Anatomy 215.) 3 units. *Anderson, Jöbsis, Johnson, or Reedy*

217. Membrane Transport. Chemical composition and ultrastructure of biological membranes, ionic and osmotic equilibria across the membranes of individual cells, passive and active ionic transport, the role of ATPase, carrier-mediated diffusion of non-electrolytes, integration of transport processes to produce molecular movements across organized epithelia, e.g. amphibian skin and bladder, and gastrointestinal mucosa. Prerequisite: permission of instructor. Fall. 3 units. *Gunn, Hall, Kirk, Lauf, Mandel, Simon, or Tosteson*

225. An Introduction to Neuronal Physiology and Pharmacology. The properties of excitable membranes in qualitative terms, including impulse generation and conduction in different types of nerves, the effects of pharmacological agents on electrical properties of membranes, the physiological and pharmacological aspects of synaptic and neuromuscular transmission, and biophysics of receptor cells. Electrophysiological techniques are presented in Physiology 386 which supplements this course. Advanced quantitative approaches to membrane biophysics including voltage clamp techniques are covered in Physiology 416. Fall. 3 units. *Narahashi, Moore, Wachtel, or Wolbarsht*

230. Molecular and Cellular Basis of Development. See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Microbiology 219, and Pathology 219.) Fall. *Padilla, Counce, Johnson, Kaufman, or McCarty*

230S. Optional seminar offered in conjunction with Physiology 230.

250. Pharmacology: Mode of Action of Drugs. The pharmacological action of drugs in terms of biochemical and physiological processes. Three lectures and one conference per week. Prerequisite: Physiology 200 or equivalent. Spring. 4 units. *Menzel or Staff*

252. Cellular and Chemical Pharmacology. Chemical aspects of cell-drug interaction and structure-activity relationships. Stereochemistry. Cholinergic and adrenergic mechanisms. Drug design. Alternate years beginning fall, 1975. 3 units. *Ottolenghi or Staff*

254. Mammalian Toxicology. Principles of toxicology as related to man. Emphasis on the molecular basis for toxicity of chemical and physical agents. Subjects include the limitations and assumptions of extrapolation to man from animal toxicity, safety drugs and food additives, toxicity of pesticides and their hazard to man, and the role of scientists in societal decisions on the use of man-made chemical and physical agents. Prerequisite: permission of instructor. Fall. 3 units. *Menzel or Staff*

256. Human Nutrition. Nutrition principles with emphasis on physiology and pharmacology. Topics include the chemical basis for nutrient requirements, application to practical diets, parenteral nutrition, influence of dietary intake on disease (cardiovascular disease, diabetes, and inborn errors of metabolism), optimal dietary intake, impact of food technology on human nutrition, growth, maturation, and lactation and their requirements and recent advances in micronutrient requirements. Prerequisite: permission of instructor. Fall. 2 units. *Menzel*

280. Student Seminar in Physiology and Pharmacology. Preparation and presentation of seminars to students and faculty on topics of broad interest to physiology and pharmacology. Required of all physiology and pharmacology graduate students. Fall and spring. 2 units. *Gunn*

For Graduates

311. Physiological Basis of Medicine. Clinical presentations followed by detailed examinations of the underlying physiological dysfunction. Topics include obstructions of hollow viscera, calcium and potassium homeostasis, temperature regulation, spinal cord injury, tissue oxygenation. Fall. 3 units. *Somjen or Staff*

321. Gastrointestinal and Renal Physiology. Mechanisms of intestinal secretion, digestion, absorption, and motility, and their control at a cellular level. Basic renal mechanisms involved in the elaboration of urine including concentrating and diluting mechanisms, hemodynamics, and regulation of acid-base balance. Spring. 3 units. *Gunn, Jones, Tosteson, or Yarger*

330. Pharmacological Basis of Clinical Medicine. This course consists of a detailed analysis of the mechanism of action and rationale for use of pharmacologic agents in disease states. Fall. 4 units. *Schanberg or Staff*

331. Laboratory Methods in Pharmacology. Tutorial laboratory training in various fields of pharmacology including neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and biophysical pharmacology. Certain special laboratory sessions are conducted at the Wellcome Research Laboratories of the Burroughs Wellcome Company, Research Triangle Park. Prerequisite: permission of instructor. Fall and spring. 3 to 6 units. *Narahashi, Maxwell, and Staff*

334. Pharmacodynamics. Introduction to the fundamentals of physical processes in biological systems as they pertain to drug action. Topics include pharmacokinetics, drug absorption, distribution, metabolism and excretion, receptor theory, Hansch correlation of molecular structure with biological activity, and molecular orbital theory. Alternate years beginning fall, 1976. 3 units. *Rosen or Slotkin*

362. Current Topics in Cardiac Muscle Physiology. Selected topics in the physiology and pharmacology of cardiac muscle, including general and comparative morphology and ultrastructure, cardiac electrophysiology and mechanics, and excitation-contraction coupling. Spring. 2 units. *Johnson or Staff*

372. Research in Physiology and Pharmacology. Laboratory investigation in various areas of physiology and pharmacology. Fall and spring. Credits to be arranged. *Staff*

383. Physiological Instrumentation. Electronic methods of measurement of physiological variables. The operational amplifier is used as the active building block in appropriate feedback circuits containing only passive elements

to make a wide range of linear instruments including analog computers. Digital logic and computing elements are also developed. Alternate years beginning spring, 1977. 3 units. Moore or Staff

386. Laboratory Methods in Electrophysiology. Laboratory training in the proper use of apparatus for stimulation recording and analysis of electrical activity of nerve, muscle, and other tissues. Designed to supplement Physiology 225. Prerequisite: Physiology 225 or equivalent. Fall. 3 units. *Wolbarsht, Anderson, Kootsey, Lieberman, Mandel, Mendell, Moore, Narahashi, or Wachtel*

393. Integrative and Clinical Neurophysiology. Aspects of the physiology and pharmacology of the central nervous system in health and in disease: sensory coding; reflex functions; motor control; effects of drugs on the CNS; physiological aspects of memory. Spring. 3 or 4 units. Extra unit available upon permission of instructor. *Somjen or Staff*

401. Metabolic and Developmental Physiology. Cell division and control of the cell cycle; population dynamics; physiology of subcellular organelles such as nuclei, mitochondria, lysosomes, and peroxisomes; metabolic regulation. Prerequisite: Biochemistry 247 or equivalent. Fall. 3 units. *Blum, Padilla, or Staff*

414. Analysis of Physiological Systems. Several physiological systems analyzed in detail, using a combination of classical mathematical analysis, model-building, and newer analog and digital techniques. Topics covered include diffusion processes, steady state and transient kinetics, and cable equations. Alternate years beginning spring, 1976. 3 units. *Moore, Blum, or Staff*

416. Biophysics of Excitable Membranes. Advanced quantitative approach to bioelectric membrane phenomena. Topics include the cable properties of axons, voltage clamping theory and techniques, the ionic mechanisms of excitation, mechanisms of synaptic and neuromuscular transmission, receptor mechanisms, models of membranes and neurons, and the pharmacology of excitable membranes. Prerequisite: Physiology 225 or equivalent; a background in calculus, physics, and physical chemistry is recommended. Alternate years beginning fall, 1976. 3 units. *Moore, Narahashi, Wachtel, or Wolbarsht*

417. Cellular Endocrinology. Current concepts of the mechanism of action of hormones at the cellular level, including hormone-receptor interactions; secondary messenger; regulation of protein synthesis; growth and differentiation; control of salt and water balance; regulation of substrate storage and mobilization; modulation of hormone secretion. Fall. 2 units. *Fellows or Lebovitz*

418. Reproductive Biology. An in-depth survey of male and female reproductive processes including neuroendocrine, pituitary and gonadal control mechanisms, and the physiology of pregnancy and parturition. (Also listed as Anatomy 418.) Spring. 2 units. *Anderson, Blake, Fletcher, Schomberg, or Tyrey*

419. Topics in Mathematical Physiology. Microcirculatory models, biological wave propagation, and dimensional analysis and scaling. Prerequisite: permission of instructor. Alternate years beginning spring, 1975. 3 units. *Blum, Moore, or Kootsey*

420. Cellular Immunophysiology. The interaction of antibodies or plant agglutinins with membrane surfaces and the resulting effects on membrane function and cell physiology. Emphasis on permeability changes in red blood

cells and certain nucleated mammalian cells mediated by immune reactions as well as on antibody induced alterations of enzyme activities. (Also listed as Microbiology 420.) Spring. 2 units. *Lauf*

422. Advanced Seminar in Endocrinology and Reproductive Physiology I. A weekly seminar based on student and faculty-led discussions of special topics in endocrinology and reproduction. Primarily designed for advanced students with active research interests relating to these areas of mammalian physiology. Prerequisite: consent of instructor. Fall. 2 units. *Fellows, Anderson, Bell, Everett, Lebovitz, Schomberg, and Tyrey*

423. Advanced Seminar in Endocrinology and Reproductive Physiology II. A continuation of Physiology 422 with discussion of topics not covered in the fall term. Prerequisites: Physiology 422 and consent of instructor. Spring. 2 units. *Fellows, Anderson, Bell, Everett, Lebovitz, Schomberg, and Tyrey*

Political Science

Professor Barber, *Chairman* (214 Perkins Library); Associate Professor Fish, *Director of Graduate Studies* (308 Perkins Library); Professors Ball, Braibanti, Cleaveland, Cole, Grzybowski, Hall, Hallowell, Holsti, Hough, Kornberg, and Leach; Associate Professors Johns, Paletz, Price, and Spragens; Assistant Professors Eldridge, Hawley, McKean, Mishler, Salamon, Trilling, and Valenzuela; Lecturers O'Barr and Stone

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government. Fields in which instruction is offered currently are American government and politics, comparative government and politics, political theory, international relations, and empirical theory and methodology.

The candidate for the degree of Doctor of Philosophy in political science must take at least twelve courses in the department and demonstrate competence in at least three general fields of the discipline as well as in a fourth general field or in a specialized sub-field or in a field external to the department. He must also demonstrate a reading knowledge of two foreign languages or he must demonstrate proficiency in one such foreign language and in the use of statistics.

Further details on the graduate program in political science, the departmental facilities, the staff, and available financial aid may be obtained from the Director of Graduate Studies, Department of Political Science.

For Seniors and Graduates

206. Politics and the Media. The relationship between the media of mass communication and the American political process. 3 units. *Paletz*

207. American Constitutional Interpretation. Major constitutional issues approached through selected Supreme Court decisions illustrating the Court's role in the governing process. Prerequisite: Political Science 127 or its equivalent. 3 units. *Fish*

208. American Constitutional Development. 3 units. *Fish*

209. Problems in State Government and Politics. 3 units. *Leach*

210. The Politics of Education. The forces in local, state, and national politics which impinge on educational policy-making and administration. (Also listed as Education 210.) Not open to students who have had Political Science 313. 3 units. *Leach*

211. Contemporary Japanese Politics. Domestic themes in postwar Japan, including the institutional structure, the legal system, local government, political parties, interest groups, the traditional political culture, participation, and the emergence of citizenship. Previous work in East Asian history or politics recommended but not required. 3 units. *McKean*

212. Japanese Foreign Policy. Japan's entrance into the international community. With emphasis on the postwar role. 3 units. *McKean*

214. Comparative Administrative Law. Comparative analysis of the role of administrative law and administrative techniques in established and transitional constitutional systems. Emphasis on French, German, British, and American patterns. Control of legality and expediency of various types of judicial review will be discussed. 3 units. *Grzybowski*

215. Comparative Legislative Processes. Offered in alternate years. Analysis of the structure and functions of legislative institutions and of the behavior of legislative elites in both parliamentary and congressional systems. 3 units. *Mishler*

216. Comparative Politics of the Welfare State. (Also listed as Public Policy Sciences 216S.) 3 units. *Stone*

220. Problems in International Politics. Ideology, modernization, and regional integration. 3 units.

221. International Organization. The functioning of the United Nations system and of regional organizations operating in the political and security fields. 3 units. *Ball*

222. Empirical Theory. Emphasis is on the theoretical status of contemporary conceptual frameworks which often rely on or generate empirical research. Prerequisite: Political Science 233 or consent of instructor. 3 units. *Trilling*

223. Political Philosophy from Plato to Machiavelli. An intensive analysis of the political philosophies of Plato and Aristotle followed by a survey of medieval political thought and an analysis of the significance of Machiavelli. 3 units. *Hallowell*

224. Modern Political Theory. A historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. 3 units. *Hallowell*

225. Comparative Government and Politics—Western Europe. Modern political institutions and processes in Western Europe. 3 units. *Cole*

226. Theories of International Relations. A survey of contemporary theories of international relations and foreign policy with an emphasis on the interdependence of theory and empirical research. 3 units. *Eldridge*

227. International Law. Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. 3 units. *Grzybowski*

228. Soviet Public International Law. Institutions and doctrines of the international law of peace as interpreted and applied by the Soviet government. Basic concepts, including the theory of socialist international law and principle of peaceful coexistence. 3 units. *Grzybowski*

229. Recent and Contemporary Political Theory. The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, nationalism, fascism and national socialism, existentialism, contemporary theories of democracy. 3 units. *Hallowell*

230. American National Government. A study of the formation, development, and contemporary operation of the national political system. The analysis employs both historical and behavioral approaches. 3 units.

231. American Political Theory. An analysis of the main currents in American political thought from colonial beginnings to the present day. 3 units.

233. Research Methodology. Measurement, causal analysis, and comparison of different levels of analysis and other problems. 3 units. *Trilling*

235. The Commonwealth. An analysis of the political relationship between the members of the Commonwealth and a comparative study of the political systems of the Commonwealth countries, with particular reference to Canada. A course designed in part to utilize the occasional services of visiting professors from Commonwealth countries. 3 units. *Cole*

236. Statistical Analysis. Introduction to statistics in political research, emphasizing inferential statistics through simple regression and correlation. 3 units. *Trilling*

237. Seminar in Problems in American Foreign Policy. The decision-making process as applied to contemporary foreign policy issues. Offered in alternate years. Prerequisite: Political Science 122 or the equivalent. 3 units. *Ball*

241. Public Administrative Organization and Management. An examination of the American administrative process, with emphasis upon the theory and practice of administrative organization and management. 3 units. *Hall*

243. Administrative and Organizational Theory. (Also listed as Public Policy Sciences 224.) 3 units. *Hawley*

244. Administrative Law and Process. The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. 3 units. *Hall*

245. Ethics and Policy-Making. (Also listed as Public Policy Sciences 223.) 3 units. *Price*

246. Administration and Public Policy. The role of administration in the American policy process. 3 units. *Hall*

247. Political Participation and Policy Outcomes. (Also listed as Public Policy Sciences 247.) 3 units. *Hough*

248. The Politics of the Policy Process. (Also listed as Public Policy Sciences 219.) 3 units. *Salamon*

249. Comparative Political Analysis and Political Development. General methodology of comparison of political systems. Institutional, structural, functional, and configurative modes of analysis. Theories of political development. Flows of technology and social change. Theoretical problems of induced political change. 3 units. *Braibanti*

250. Comparative Government and Politics—Southern Asia. Political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional and institutional aspects of the political systems. Impact of foreign technical assistance. 3 units. *Braibanti*

252. Comparative Political Behavior and Socialization. Elites and mass publics in Western and non-Western societies including the United States. Models of the political socialization process and their implications for democratic theory. 3 units. *Mishler*

253. Comparative Government and Politics: Latin America. An analysis of current publications in comparative politics, applicable to an understanding of the major themes of Latin American politics. 3 units. *Valenzuela*

260. The Tradition of Political Inquiry. A study of the problems, goals, presuppositions, and methods of political inquiry, past and present. 3 units. *Spragens*

266. Soviet Foreign Policy. 3 units. *Hough*

271. Political Processes in Traditional and Modern Africa. An analysis of patterns of change in selected African societies from the pre-colonial to the post-colonial period. The focus of the course will be upon the interaction between traditional, colonial, and post-colonial institutions and their impact upon African societies. (Also listed as History 219.) 3 units. *Johns*

273. Modernization in the American South. 3 units. *Salamon*

274. Political Psychology. Psychological aspects of political performance by citizens, activists, and leaders. 3 units. *Barber*

275. The American Party System. An intensive examination of selected facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, and the controversy over party government. 3 units. *Kornberg*

277. Comparative Party Politics. The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. 3 units. *Kornberg*

278. Canadian Political Behavior in the North American Context. Institutional processes and political behavior in Canadian and American societies. Impact of multi-partyism, federalism, political and cultural particularism, and the elite structure. 3 units. *Kornberg*

279. The Legislative Process. A behavioral analysis of the American legislative process with emphasis on Congress. Some consideration will also be given to legislatures in other countries. 3 units. *Paletz*

280. Comparative Government and Politics—Sub-Saharan Africa. Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. 3 units. *Johns*

283. Congressional Policy-Making. Lawmaking and oversight in the U.S. Congress. Committee roles, impact of the executive and other external forces. (Also listed as Public Policy Science 283.) 3 units. *Price*

285. The Judicial Process. A study of judicial decision-making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisites: Political Science 127 and 207 or their equivalents. 3 units. *Fish*

291. Problems of Urban Government. 3 units. *Leach*

293. Federalism. Theoretical and operational aspects of federal systems of government, focusing on the United States and Canada. 3 units. *Leach*

For Graduates

303. Seminar on Selected Topics in Statistics. Introduction to the assumptions and uses of selected multivariate statistics and research methodologies including least-squares analysis, scaling techniques, factor analysis, causal inference, model-building, and computer simulation. Prerequisite: Political Science 236 or permission of the instructor. 3 units. *Mishler*

305. Seminar in Foreign Policy. Models of foreign policy, with some emphasis on the belief systems of foreign policy decision-makers. The seminar will combine critical reading of the literature and some original research. 3 units. *Holsti*

306. Seminar in Politics and the Mass Media of Communication. Prerequisite: Political Science 206 or consent of the instructor. 3 units. *Paletz*

307. Graduate Seminar in American Voting Behavior. Focus on contemporary and original research in American voting behavior. 3 units. *Trilling*

310. Seminar in State and Local Government. (Offered in alternate years.) Prerequisites: Political Science 209 and 291 or their equivalents. 3 units. *Leach*

312. Seminar in Constitutional Law. Prerequisite: Political Science 207 or the equivalent. 3 units. *Fish*

313. Education and Public Policy. (Also listed as Education 313.) Not open to students who have had Political Science 210. 3 units. *Leach and Pittillo*

321. Seminar in Political Theory. (Offered in alternate years.) Prerequisites: 6 units in Political Science 223, 224, 229, 231 or equivalents. 3 units. *Hallowell*

322. Seminar in Selected Topics in Empirical and Formal Theory. Examination of the empirical and formal treatment of concepts such as power, support, rationality and collective choice. Prerequisite: Political Science 222 or 233, or consent of instructor. 3 units. *Trilling*

325. Seminar in Comparative Government and Politics. (Offered in alternate years.) Prerequisites: 6 units in Political Science 225, 249, 250, 251, 253, 280 or the equivalents. 3 units. *Cole*

328. Seminar in International Law. Prerequisite: Political Science 277 or the equivalent. 3 units. *Grzybowski*

329. Seminar in International Regional Organization. (Offered in alternate years.) Prerequisite: Political Science 221 or the equivalent. 3 units. *Ball*

330. Seminar in Comparative Government and Politics—Southern Asia. Emphasis on research using documentary materials relating to India, Pakistan, Ceylon, and Malaysia. Prerequisites: Political Science 250, 251, or equivalents. Offered in alternate years. *Braibanti*

331. Seminar in American Political Thought. 3 units. *Leach*

341. Seminar in Public Administration. Selected topics in administrative and organizational theory and behavior. Prerequisite: Political Science 141 or 243. 3 units.

342. Seminar in American National Government and Politics. Prerequisite: Political Science 230 or its equivalent. 3 units. *Barber*

343. Seminar in the Policy Process. Selected topics covering the theory, methodology, and practice of policy formation in American politics. Prerequisite: Political Science 246 or its equivalent. 3 units.

344. Workshop on Computer Models of Social Systems. (Also listed as Computer Science 344 and Economics 344.) 3 units. *Naylor*

360. Seminar in Government and Politics in the Soviet Union. Prerequisite: Political Science 165, or consent of instructor. 3 units. *Hough*

361. Seminar in Foreign Relations of the Soviet Union. Prerequisite: Political Science 220 or 360, or consent of instructor. 3 units. *Hough*

376. Seminar in Comparative Political Behavior. An intensive comparative examination of the impact of selected political institutions on political behavior. (Offered in alternate years.) 3 units. *Kornberg*

380. Seminar in African Government and Politics. Prerequisite: Political Science 280 or its equivalent. 3 units. *Johns*

381. Seminar in Latin American Government and Politics. Prerequisite: Political Science 253 or the equivalent. (Offered in alternate years.) 3 units. *Valenzuela*

382. Soviet Law and Society. 2 units. *Grzybowski*

401. Seminar in the Commonwealth. 3 units. *Ball and Members of the Committee on Commonwealth Studies*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

Related Course Work in the School of Law

There may be graduate credit for course work completed in the Duke University School of Law, under regulations referred to in this *Bulletin* under Academic Regulations.

Psychology

Professor Alexander, *Chairman* (244 Psychology-Sociology Building); Professor Staddon, *Director of Graduate Studies* (242 Psychology-Sociology Build-

ing); Professors Bevan, Borstelmann, Brehm, Carson, Diamond, R. Erickson, Guttman, Jones, Lakin, Lockhead, Schiffman, M. Wallach, and Wing; Associate Professors Coie, Costanzo, C. Erickson, Hall, and McConahay; Assistant Professors Aderman, Eckerman, Fischer, Kalat, Kremen, Levy, Norton, Robinson, Roth, and White; Lecturers Casseday, Crovitz, Gentry, Oppenheim, Peele, Shows, Somjen, L. Wallach, and Wolbarsht

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

For Seniors and Graduates

203. Sensation and Perception. An examination of the classical concepts in sensation and perception and of the resulting psychophysical data for each of the major senses with emphasis on vision and audition. Modern perceptual formulations are discussed through analysis of the empirical evidence in support of each view. 3 units. *Lockhead*

206. Comparative Psychology. Eminent comparative psychologists and their work. 3 units. *Kalat*

210. Cognitive Psychology. Theoretical approach; stresses interconnections across perception, memory, thinking, language, and use of models. 3 units. *Robinson*

213. Adaptive Behavior. The principles of adaptive behavior, with special emphasis on the effects of reinforcement. Prerequisite: consent of instructor. 3 units. *Staddon*

215. Developmental Psychology. Theories of human development. 3 units. *L. Wallach or Staff*

216. Biological Psychology. The methods of biology, as applied to psychology, especially in neurophysiology, neuroanatomy, and genetics. Topics covered include the genetics of behavior, the organization of the dorsal thalamus and neocortex, and the limbic system and hypothalamus. Methods covered include ablation method, method of evoked potentials, electrical stimulation of the brain, and classical and physiological genetics. 3 units. *Diamond*

217. Social Psychology. Social factors in cognition, models of social interaction, conformity and social influence, and attitude development and change. 3 units. *Jones*

218. Research Methods in Social Psychology. The theory and practice of data collection methods in social psychology. Emphasis is on the interplay between experimental design and technique. 3 units. *Aderman*

219. Neural Bases of Behavior. Structure and function of the nervous system as related to problems of sensorimotor processes, learning, and memory. 3 units. *R. Erickson*

228. Visually Guided Behavior. Anatomical and physiological maturation of the nervous system structures mediating visual behaviors. How the maturation of the visual pathway may contribute to the development of these behaviors. 3 units. *Norton*

230. Social Behavior of Animals. Developmental, ecological, and physiological aspects of territorial, sexual, parental, and aggressive behavior. 3 units. *C. Erickson*

234. Seminar in Personality. Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. 3 units. *M. Wallach*

245. Personality Theory I. Representative theories of human functioning, from Freud to neoanalytic approaches. 3 units. *Alexander or Staff*

246. Personality Theory II. Representative models of human functioning, as field theory, behavior theory, type or trait theory, and ego psychology. 3 units. *Alexander or Staff*

271. Seminar. Selected problems. 3 units. *Staff*

273-274. Principles of Psychological Measurement. Measurement theory and the problems of scientific inference. Topics will include methods of data analysis, psychometric scaling, and test construction. Prerequisite: Mathematics 232 or equivalent. 3 units per semester. *Schiffman*

276. Neuroanatomical Basis of Sensory Physiology. (Also listed as Anatomy 276.) 3 units. *Hall*

282. Introduction to Methods in Psychotherapy. Current trends in psychotherapeutic practice and research. Application of principles drawn from theories of personality to individual and group psychotherapy. Prerequisite: consent of the instructor. 3 units. *Carson, Lakin, or Martin*

283, 284. The History of Psychology. First semester, Aristotle to Kant; second semester, development of modern psychology. Prerequisite for 284: Psychology 283 or permission of instructor. 3 units per semester. *Guttman*

291. Seminar in Community Mental Health. Psychological epidemiology and ecology; primary, secondary, and tertiary prevention; the public-health approach to problems of psychological disorders and psychological well-being. Focus on intervention techniques, such as consultation and community action planning. 3 units. *Staff*

293. Methods in Developmental Psychology. Methodological and epistemological issues in research in development. Individual and group research projects are an integral part of the course. 3 units. *Staff*

For Graduates

305. Psychopathology. An examination of behavior disorders, with particular emphasis on explanatory concepts and the evidence from research in this field. 3 units. *Staff*

306. Seminar in Developmental Psychology. Selected topics in cognitive, emotional and social development. 3 units. *Staff*

309. Seminar in Learning. Selected topics in operant conditioning and discrimination learning. 3 units. *Staddon*

310. Seminar in Perception. 3 units. *Lockhead*

313. Seminar on the Concept of the Reflex. A consideration of the reflexological principles found in the works of Sherrington, Sechenov, Pavlov, Eccles, Skinner, Konorski, *et al.*, and an examination of the critiques of Goldstein, Lashley, and others. 3 units. *Diamond and Guttman*

314. Seminar in Instrumental Behavior. 3 units.

316. Seminar in Social Psychology. 3 units. *Jones*

317. Seminar in Social Behavior. 3 units.

318. Seminar in Social Influence. 3 units. *Brehm*

319-320. Research-Clinical Tutorial. 6 units. *Staff*

321. Seminar in Psychophysiology of Hearing. An examination of the relation of anatomy and physiology to psychophysics of the auditory system. Prerequisite: permission of the instructor. 3 units. *Casseday*

325. Seminar in Animal Behavior. Selected topics in the reproductive behavior of animals. 3 units. *C. Erickson*

327, 328. Foundations of Clinical Psychology. A review in depth of selected issues, concepts, and empirical findings of general psychology that have immediate or potential relevance to the theory and practice of clinical psychology. The several subdisciplines such as social, developmental, and biological psychology will be scanned so as to identify content areas that intersect with or have implications for the concerns of clinical-personality psychology. 3 units per semester. *Carson or Staff*

329-330. Seminar in Psychology. An intensive examination of original sources in experimental and biological psychology. Ordinarily taken by all students in the natural science division in their first year of residence. 6 units. *Staff*

333, 334. Seminar: Behavioral Studies of the Brain. Selected topics in the neural bases of behavior. 3 units per semester. *R. Erickson*

335-336. Clinical Inquiry I. This course focuses on the process of understanding intra- and inter-person systems, largely in a practicum context. 6 units. *Staff*

337. Seminar in Sensory Discrimination. The neural bases of discrimination in vertebrates and invertebrates is studied by neurophysiological, electrophysiological, and psychophysical techniques. 3 units. *R. Erickson and Wolbarsht*

340. Group Processes and Sensitivity Training. 3 units. *Lakin*

343, 344. Clinical Inquiry II. Intensive experience and supervision in techniques of psychotherapy and behavior modification. 3 units per semester. *Staff*

347-348. Personality Assessment. Introduction to the assessment of human personality through the study of personal documents, interview data, objective and projective test material. Laboratory sessions will be concerned with personality assessment of normal human subjects over extended time periods. 6 units. *Alexander or Kremen*

350. Practicum in Psychological Research. Ordinarily taken by all students in the natural science division in their first semester of residence. 3 units. *Staff*

393. Integrative and Clinical Neurophysiology. (Also listed as Physiology 393.) 3 units. *Somjen or Staff*

Public Policy Sciences

Professor Fleishman, *Director*; Associate Professor Hawley, *Associate Director*; Associate Professor Behn, *Director of Graduate Studies* (109 Old Chemistry); Professors Estes (Medicine), Hough (Political Science), and Lange (Law); Associate Professors McConahay and Price; Assistant Professors Bell (Law), Cook, Dajani (Engineering), Fischer, Salamon, and Vaupel; Lecturers Lipscomb, Payne, and Stone

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the degrees of Master of Arts in public policy sciences, and a doctoral or professional degree. Such a program is designed to foster in highly trained professionals the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees.

With the exception of those individuals already possessing doctoral or professional degrees, therefore, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond that which their doctoral or professional degree would require alone.

The joint degree curriculum involves a minimum of ten courses, to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy-research sequence, in which the student works closely with faculty in tutorial or small group situations, stresses the development of analytical skills applicable to the broad range of policy arenas.

Further information concerning specific joint degree programs may be obtained from the Director of Graduate Studies (109 Old Chemistry).

For Seniors and Graduates

216S. Comparative Politics of the Welfare State. Political processes that shape different solutions to similar social problems in advanced industrial nations. Development of income-maintenance programs and health care systems, with some discussion of other social policies. (Also listed as Political Science 216.) 3 units. *Stone*

217. The Application of Microeconomics to Public Policy-Making. Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision-making. 3 units. *Cook or Lipscomb*

219. The Politics of the Policy Process. Influence of the policy-making process on the substance of public policy. Impact of group pressures, congressional and administrative processes, and inter-governmental relations, particularly in the United States. (Listed also as Political Science 248.) 3 units. *Behn or Salamon*

221. Analytical Methods I: Forecasting Consequences of Policy Alternatives. The decision analysis approach as a strategy for policy-making; uses and limitations of deterministic, probabilistic, unitary, and interactive models for guesstimating the consequences of policy alternatives, including modeling techniques for structuring policy problems and statistical techniques for gathering and processing data for models. 3 units. *Fischer or Vaupel*

222. Analytical Methods II: Appraising Consequences of Policy Alternatives. Various methods for appraising and weighing the consequences of policy alternatives, including the uses and limitations of economic utility theory, probabilistic preference theory, time preference, multi-attribute preference trade-offs, cost/effectiveness analysis, cost/benefit analysis, scoring systems, performance indices, objective functions, indifference curves, Pareto optimality, market and shadow prices, willingness to pay consumer's surplus; concludes with a discussion of some formal decision analysis and mathematical programming. Prerequisite: Public Policy Sciences 221. 3 units. *Fischer or Vaupel*

223. Ethics and Policy-Making. Normative concepts in politics—liberty, justice, the public interest—in terms of historical and philosophical roots, and implications for domestic policy. (Also listed as Political Science 245.) Prerequisite: permission of instructor. 3 units. *Price*

224. Administrative and Organizational Theory. A behavioral analysis of public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Listed also as Political Science 243.) 3 units. *Hawley*

247. Political Participation and Policy Outcomes. Impact of citizen participation upon governmental decision-making. Theoretical issues and empirical evidence, primarily American, but partly comparative. (Listed also as Political Science 247.) 3 units. *Hough*

251. Advanced Analytical Methods for Public Policy-Making. The theory and computer-assisted implementation of regression analysis and simulation modeling for public policy research. 3 units. *Cook or Vaupel*

252S. Seminar in National Security Policy. Application of normative and organizational theory, and historical, systems, and decision analysis to major strategic decisions, and selected foreign policy issues. 3 units. *Fischer*

253. Psychological Approaches to Public Policy Analysis. Examines how psychological analysis contributes to an understanding of a range of social issues including poverty, drug abuse, crime, crowding and race relations. How psychological perspectives affect the ways problems are recognized and defined. Emphasis is given to the social psychological factors that lead to the selection of different policy alternatives, e.g., those that "blame the victim." 3 units. *McConahay*

254. Transportation Planning and Policy Analysis. (Also listed as Civil Engineering 216.) Prerequisite or corequisite: C.E. 116 or consent of instructor. 3 units. *Behn or Dajani*

260. Public Policy Research Seminar: The Administration of Justice. 3 units. *Staff*

261S. Research Seminar: Health Policy I. Determinants and impacts of

public policies designed to improve the equity and efficiency of health services. The supply and distribution of services; the cost of services and alternative modes of financing; the quality of services and alternative mechanisms of quality control. Students will be required to prepare an applied research paper. 3 units. *Lipscomb and Stone*

262S. Research Seminar: Communications I. 3 units. *Staff*

263. Public Policy Research Seminar: Urban and Regional Land Use Planning I. Examines the dynamics of urban and regional development and analyzes alternative policy instruments for coping with the social, environmental, and economic impacts of this development. Topics to be covered include housing, land use, transportation, taxation, environmental protection, and related urban development problems and policies. A substantial paper on an aspect of urban development policy constitutes the major requirement. Prerequisite: Political Science 176, Political Science 109, Economics 234 or consent of instructor. 3 units. *Salamon*

264. Public Policy Research Seminar: Topics in Public Policy I. An introduction to issues in selected areas of public policy. Students prepare for, or engage in, a major research study. 3 units. *Staff*

270S. Humanistic Perspectives on Public Policy. Aspects of social life important to policy-makers but beyond the normal reach of social science. Readings from James Agee, Robert Coles, Eudora Welty, James Baldwin, George Eliot, and others. Prerequisite: consent of the instructor. 3 units. *Payne*

271. The Uses of History in Public Policy-Making. Introduction to historical analysis as a technique for formulating and evaluating public policy. 3 units. *Staff*

283. Congressional Policy-Making. (Also listed as Political Science 283.) 3 units. *Price*

For Graduates

310. Analytical Methods III: Experimentation and Evaluation. Focuses on methods for monitoring and evaluating public policies. Topics include the design and implementation of social experiments to test policy options, the uses of surveys and quasi-experiments based on historical data, detecting and measuring unanticipated consequences, and the design and use of social indicators. Case studies include the negative-income-tax experiment, the health-insurance experiment, the Salk polio vaccine experiment, the National Halothane Study, the Equality of Educational Opportunity Study, and an evaluation of the U.S. Space Program. 3 units. *Fischer or McConahay*

391. Multinational Corporations Seminar. The nature and consequences of multinational corporations. The international economic environment in which multinational corporations operate. The problems of managing a multinational corporation. Public policy toward multinational corporations. (Also listed as Business Administration 391.2.) 3 units. *Vaupel*

340-390. Public Policy Research Seminars. Students pursuing a Master of Arts degree in public policy sciences are expected to take a series of three or four sequential courses which examines issues in specialized public policy areas, such as: law and the administration of justice, communications, health, urban and regional land use, and education. The series begins with a 260 level course, continues with courses from this series, and includes a thesis seminar and an optional summer internship. 12 units. *Staff*

Religion

Professor Poteat, *Chairman*; Professor M. Smith, *Director of Graduate Studies* (209 A Divinity School); Professors Baker, Beach, Bradley, Cushman, Davies, Henry, Herzog, Lacy, Langford, Long, Murphy, Osborn, Price, and Young; Associate Professors Bailey, Clark, Kort, Meyers, Partin, Raitt, Robinson, H. Smith, Steinmetz, and Wintermute; Assistant Professors Charlesworth and Lawrence

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) biblical studies; (2) historical studies; and (3) systematic and contemporary studies. They will be expected to take such courses in one or both of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as classical studies, history, political science, or sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

FIELD I. BIBLICAL STUDIES

207. Second Hebrew. Historical Hebrew grammar with reading and exegesis of Old Testament prose: Pentateuch and historical books in alternate years. First semester. 3 units. *Wintermute*

208. Second Hebrew. Historical Hebrew grammar and rapid reading of prose and poetry. Second semester. 3 units. *Murphy*

209. Old Testament Theology. Studies of the Old Testament in regard to theological themes and content. 3 units. *Murphy*

220. Third Hebrew. An interpretive study of late Hebrew prose, with readings from Chronicles, Ecclesiastes, and the Mishnah. 3 units. *Meyers*

221. Readings in Hebrew Biblical Commentaries. Selected Hebrew texts in Midrash Aggadah and other Hebrew commentaries reflecting major trends of classical Jewish exegesis. 3 units. *Bland*

223A. Exegesis of the Hebrew Old Testament: Amos and Hosea. Interpretation based upon Hebrew exegesis, stress upon hermeneutic methods. 3 units. *Bailey*

223B. Exegesis of the Hebrew Old Testament: Job. 3 units. *Murphy*

223C. Exegesis of the Hebrew Old Testament: Exodus. 3 units. *Bailey*

225. Living Issues in New Testament Theology. Critical examination of major problems and issues in New Testament interpretation and theology. 3 units. *M. Smith*

226A. Exegesis of the Greek New Testament I (Mark and Matthew). 3 units. *Price or Smith*

226B. Exegesis of the Greek New Testament I (Romans). 3 units. *Price*

226D. Exegesis of the Greek New Testament I (I and II Corinthians). 3 units. *M. Smith*

226E. The Gospel and Epistles of John. Exegesis of the Johannine literature in Greek. 3 units. *M. Smith*

227A. Exegesis of the Greek New Testament II (Luke-Acts). 3 units. *Young*

227B. Exegesis of the Greek and New Testament II (Galatians). 3 units. *Smith*

227C. Exegesis of the Greek New Testament II (The Pastoral Epistles). 3 units. *Young*

228. The Theology of the Gospel and Epistles of John. A study of the origin of these writings; the provenance of their thought forms and symbolism; their influence on the early church; and contemporary significance. 3 units. *Price*

237. History of the Ancient Near East. Emphasis upon the religions, literature, and art of Mesopotamia. 3 units. *Bailey*

239. Introduction to Middle Egyptian. Grammar and readings in hieroglyphic texts relating to the Old Testament. 3 units. *Wintermute*

242. Life After Death in Semitic Thought. Consideration of the various ideas from the early second millennium through the Intertestamental Period. Exegesis of selected Old Testament passages. Evaluation of recent research. Knowledge of Hebrew helpful but not required. 3 units. *Bailey*

244. The Archaeology of Palestine in Hellenistic-Roman Times. The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. Prerequisite: reading knowledge of a biblical language. 3 units. *Meyers*

258. Coptic. Introduction to the Sahadic dialect with selected readings from Christian and Gnostic texts. Prerequisite: at least one year of Greek. 3 units. *Wintermute*

302. Studies in the Intertestamental Literature. Selected documents of the Apocrypha and Pseudepigrapha examined exegetically and theologically in their relation to post-exilic Judaism. Prerequisite: permission of instructor. 3 units. *Charlesworth*

304. Aramaic. A study of the Aramaic portions of the Old Testament and selected passages from the Targums, Midrashes, and Talmuds. 3 units. *Meyers or Murphy*

304A. Targumic Aramaic. An introduction to the language and literature of the Aramaic translations of the Old Testament. 3 units. *Meyers*

306. Language and Literature of the Dead Sea Scrolls. A study in interpretation. Prerequisite: a knowledge of Hebrew. 3 units. *Charlesworth*

307. Syriac. A study of the script and grammar, with readings from the Syriac New Testament and other early Christian documents. Prerequisite: some knowledge of Hebrew and Aramaic. 3 units. *Charlesworth*

311. Pharisaic Judaism in the First Century. A reading course in first-century Pharisaic Judaism. 3 units. *Davies*

312. Pauline Theology. Studies in aspects of Paulinism in the light of recent scholarship. 3 units. *Davies*

314. Judaism and Christianity in the New Testament. Their interaction. 3 units. *Davies*

319. The Gospel According to St. Matthew in Recent Research. 3 units. *Davies*

323A. Comparative Semitic I. An introduction to the morphology and syntax of classical Arabic and the Semitic languages of Mesopotamia, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

323B. Comparative Semitic II. An introduction to the morphology and syntax of classical Ethiopic and the Semitic languages of Palestine-Syria, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

340-341. Seminar in the New Testament. Research and discussion on a selected problem in the biblical field. 3 units per semester. *Price, Smith and Young*

345. The Epistle to the Hebrews in Recent Research. Intensive attention to the text and to secondary sources. 3 units. *Davies*

350-351. Old Testament Seminar. Research and discussion on selected problems in the Old Testament and related fields. 3 units per semester. *Murphy*

353. Seminar on Text Criticism. Emphasis upon transmission, versions, apparatus, and method. Prerequisite: reading knowledge of Hebrew and Greek. 3 units. *Bailey*

373-374. Elementary Akkadian. Study of the elements of Akkadian grammar. Reading of neo-Assyrian texts shedding light on the Old Testament. Prerequisite: biblical Hebrew. 6 units. *Bailey*

375-376. Elementary Ugaritic. Study of the elements of Ugaritic. Prerequisite: biblical Hebrew. 6 units. *Bailey*

401. Colloquium in Biblical Studies. A colloquium in which all graduate faculty and students in the biblical division participate. Research papers in the biblical field are read and discussed.

FIELD II. HISTORICAL STUDIES

217. Islam in India. History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millenium A.D. 3 units. *Lawrence*

218. Religion in Japan. A survey of religion in Japan, with special emphasis on indigenisation and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. 3 units. *Corless*

236. Luther and the Reformation in Germany. The theology of Martin Luther in the context of competing visions of reform. 3 units. *Steinmetz*

238. Jewish Responses to Christianity. Apologetic and polemical themes in rabbinic, medieval, and contemporary writings. 3 units. *Bland*

241. Problems in Reformation Theology. 3 units. *Steinmetz*

246. Problems in Historical Theology. Prerequisite: permission of instructor. 3 units. *Raitt*

247. Readings in Latin Theological Literature. Critical translation and study of important theological texts in Latin from various periods of the history of the Church. 3 units. *Steinmetz or Raitt*

251. The Counter-Reformation and the Development of Catholic Dogma. Issues in Roman Catholic theology from the Reformation to the Second Vatican Council. 3 units. *Raitt*

260. Seminar: Wesley Studies. The lives and thoughts of John and Charles Wesley and their colleagues in relation to English culture and religion in the eighteenth century. 3 units. *Baker*

280. The History of Religions. A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. 3 units. *Partin*

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions. Particular attention will be given to religious pilgrimage. 3 units. *Partin*

283. Religions of East Asia. A study of the major traditions of China and Japan, with emphasis on the development and expansion of Buddhism. 3 units.

284. The Religion and History of Islam. A study of the origins and development of the Islamic tradition and community, with particular attention to the religious element. 3 units. *Partin*

285. The Vedic Tradition: Its Compilation and Interpretation. A study of Indian canonical writings, with emphasis on the literary stages and relation of the writings to later philosophical and religious movements. 3 units. *Lawrence*

287. The Scriptures of Asia. Intensive study of translations of basic texts from the religious traditions of India, China, and Japan. 3 units. *Bradley*

288. Buddhist Thought and Practice. A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. 3 units. *Corless*

289. World Religions and Social Change. The role of religious traditions and institutions in national and international affairs. Intensive study of selected areas of Asia and Africa, with special stress on missionary religions and political change. 3 units. *Bradley*

296. Religion on the American Frontier. A study of the spread of evangelical Christianity as a theological and cultural phenomenon of the American West. 3 units. *Henry*

308. Greek Patristic Texts. Critical translation and study of selected Greek texts illustrative of significant aspects of patristic theology and history from the second through the fifth century A.D. 3 units. *Young*

313. The Apostolic Fathers. A study of the religious thought in the writings of the Apostolic Fathers. 3 units. *Young*

315-316. Seminar: History of Religions. Selected problems in the field. 3 units.

317. Seminar in the Greek Apologists. A study of the apologetic writings

of the Greek Fathers in relation to the challenges of their contemporary world. Special attention will be given to leading protagonists of late Graeco-Roman culture, such as Celsus, Porphyry, and Julian. 3 units. *Young*

318. Seminar in the Greek Fathers. A study of selected topics from the Greek Fathers. 3 units. *Young*

324. Readings in the History of Religion. An examination of the theories, methods, and purposes of the study of non-Western religions within the Western tradition. 3 units. *Long*

334. Theology and Reform in the Later Middle Ages. The life and thought of the medieval Church from the 12th century through the 15th. Popular and academic theologians from Pierre Abelard to Gabriel Biel. 3 units. *Steinmetz*

335. The English Church in the Eighteenth Century. Studies of Christianity in England from the Act of Toleration, 1689, to the death of John Wesley, 1791. 3 units. *Baker*

336. Christian Mysticism in the Middle Ages. Source studies in historical perspective of such late medieval mystics as Bernard of Clairvaux, the Victorines, Ramon Lull, Meister Eckhart, Richard Rolle, Catherine of Siena, and Nicholas of Cusa. 3 units. *Raitt*

338. Calvin and the Reformation in Switzerland. The theological development of John Calvin. A comprehensive examination of his mature position with constant reference to the theology of the other reformers. 3 units. *Steinmetz*

339. The Radical Reformation. Protestant movements of dissent in the sixteenth century. Special attention will be devoted to Müntzer, Carlstadt, Hubmaier, Schwenckfeld, Denck, Marpeck, Socinus, and Menno Simons. 3 units. *Steinmetz*

344. Zwingli and the Origins of Reformed Theology. Source studies in the early Reformed tradition. 3 units. *Steinmetz*

384. Religious Dissent in American Culture. History and significance of dissent in the theology and culture of America. 3 units. *Henry*

385. Religion in American Literature. A critical study of the meaning and value of religious motifs reflected in American literature. 3 units. *Henry*

391. Historical Types of Christian Ethics I. A critical study of representative statements of Christian ethical theory, through the early Reformation. 3 units. *Beach*

392. Historical Types of Christian Ethics II. A continuation of Religion 391, from the Reformation through current Christian ethical theory. Prerequisite: Religion 391. 3 units. *Beach*

395. Christian Thought in Colonial America. Exposition of the main currents in Protestant theology. 3 units. *Henry*

396. Liberal Traditions in American Theology. A study of the main types of modern religious thought, beginning with the theology of the Enlightenment. 3 units. *Henry*

FIELD III. SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology. A study of twentieth century Bri-

tish theology. Attention will be given to the Anglican, Free Church, and Scottish traditions. 3 units. *Langford*

211. Authority in Theology. The idea and function of authority in theology. 3 units. *Langford*

214. The Christian Doctrine of Salvation. A systematic exposition and restatement of the historic faith of the Church in relation to representative secular alternatives of ancient and modern times. 3 units. *Cushman*

230. The Meaning of Religious Language. An analysis of the credentials of some typical claims of theism in the light of theories of meaning in recent thought. (Also listed as Philosophy 230.) 3 units. *Poteat*

231. Seminar in Christianity and Contemporary Thought. Analytical reading and discussion of such critical cultural analysis as is found in the works of M. Polanyi, Arendt, Trilling, and others, with appraisal of the relevance of theological inquiry. 3 units. *Poteat*

232. Religion and Literature: Perspectives and Methods. A study of literary works and their religious origins, parallels, and implications as analyzed and interpreted by myth or archetype critics and by theological critics. 3 units. *Kort*

233. Modern Narrative and Religious Language. A study of the fiction of selected American, British, and Continental writers of the first half of the twentieth century, with special attention to the role of religious language in their work. 3 units. *Kort*

245. Ethics in World Religions. Moral foundations, assumptions, and applications in such major faiths as Hinduism, Buddhism, Confucianism, and Islam, in the light of Christian ethical perspectives. 3 units. *Lacy*

248. The Theology of Karl Barth. A historical and critical study of the theology of Karl Barth. Prerequisite: permission of the instructor. 3 units. *Osborn*

249. The Church in Contemporary Theology. A critical and systematic study of the doctrine of the Church in contemporary Christian thought. 3 units. *Osborn*

262. Marxist Ideology and Christian Faith. Comparative examination of Communist and Christian doctrines, such as man, society, sin, history, and eschatology, together with an introduction to the contemporary dialogue. 3 units. *Lacy*

272. Seminar in Topics in Comparative Theology. Theological categories in Christian and Eastern Religious traditions, focusing on such topics as man, God, salvation, eschatology. 3 units. *Lawrence and Osborn*

281. Phenomenology and Religion. Scheler, E. Strauss, Merleau-Ponty, Ricoeur, Binswanger, or others; their bearing upon religious knowledge and practice. Prerequisite: permission of instructor. 3 units. *Poteat*

292. Christian Ethics and International Relations. An examination of Christian attitudes toward such issues as war and peace, the rule of law, foreign aid, and human rights; and the Church's contribution to international policies and institutions. 3 units. *Lacy*

293. Sociological Analysis of Religion. An analysis of the way in which various components of a religion (belief-systems, liturgical practices, ethical

teachings, institutional structure, and modes of operation) function in relation to social cohesion, social conflict, and social reform. 3 units. *Clark*

294. Institutional Analysis of Religious Bodies. A study of the internal structures and dynamics of religious groups. 3 units. *Clark*

295. Ethics and Economic Life. A survey of the historical teachings of the Christian churches in the areas of economic life, an analysis of contemporary norms of economic justice, and an exploration of current public and private economic policies and the policy-making processes. 3 units. *Clark*

300. Systematic Theology. Method and structure of systematic theology, the doctrine of God, theological anthropology, and Christology. 3 units. *Cushman, Herzog, or Langford*

303. The New Hermeneutic and the Idea of History. A critical examination of key thinkers in present-day European systematic theology: Fuchs, Ebeling, Moltmann, Ott, and Pannenberg, in the light of Ernst Bloch's philosophy. 3 units. *Herzog*

320. Hegel and Schleiermacher. A study of two makers of modern Protestant thought. 3 units. *Herzog*

322. Nineteenth Century European Theology. Protestant theology from Kant to Herrmann. 3 units. *Herzog*

325. Philosophical Theology I. Theology, as the knowledge of God, considered in dialogue with selected pagan and Christian philosophers from Plato to Kant. 3 units. *Cushman*

326. Philosophical Theology II. Continuation of Philosophical Theology I. 3 units. *Cushman*

328. Twentieth Century European Theology. Critical examination of the thought of selected Protestant theologians from 1900 to 1950. 3 units. *Herzog*

352. Seminar in Christian Theology. Research and discussion of a selected problem in the systematic field. 3 units. *Staff*

360. Special Problems in Religion and Culture. Intensive investigation of the relations of religion and modernity, using seminal contemporary texts. Topics announced each semester. Prerequisite: permission of instructor. 3 units. *Poteat*

361. Language and Biblical Criticism. An attempt to explore the bearing of recent investigators into the nature of language upon problems in the study of biblical texts. Prerequisite: permission of both instructors. 3 units. *Poteat and Charlesworth*

377. Contemporary American Dramatic Arts and Evolving Theological Forms. An examination of creed and ritual implicit and explicit in contemporary American theater, film, and television. 3 units. *Henry*

380. Existentialist Thought. An exploration of the interests and motifs of Existentialism in relation to modern philosophy and theology through an analysis of representative writings of Kierkegaard, Heidegger, Berdyaev, Marcel, and Sartre. 3 units. *Poteat*

383. Moral Theology in the Twentieth Century. Critical and comparative examination of ethical theory as exhibited in the work of selected contemporary theologians. 3 units. *H. Smith*

386. Christianity in Dialogue with Other Faiths. Contemporary currents of Christian thought as they affect resurgent non-Christian faiths, new formulations of a theology of mission, and ecumenical conversations. 3 units. *Lacy*

388. Ethics and Medicine. A critical study of selected aspects of modern biomedical technology, with special reference to the ethical assumptions informing their development and practice. 3 units. *H. Smith*

389. Christian Ethics and Contemporary Culture. A study of the interaction between Christian thought and current social theory. 3 units. *Beach*

390. Current Problems in Christian Ethical Theory. A critical study of dominant issues in Christian ethics, such as community, conscience, contextualism, power, and technology. 3 units. *Beach*

394. Christianity and the State. The relation of the Christian theory of the State to political problems, with special consideration of the religious assumptions underlying democratic theory and practice and of the relationship of church to state. 3 units. *Beach*

397. Contemporary American Theology. A critical appraisal of major tendencies. 3 units. *Henry*

398. Colloquium on the College and University Teaching of Religion. The theological issues of religion in higher education; a consideration of the curricular content of religion courses. Usually expected of Level III students in Fields I, II and III in residence. *Young and Staff*

Romance Languages

Professor Tetel, *Chairman* (205 Foreign Languages); Associate Professor Vincent, *Director of Graduate Studies* (214 Foreign Languages); Professors Cordle, Davis, Fein, Fowlie, Niess, Predmore, and Wardropper; Associate Professors Garci-Gómez, Hull, and Stewart; Assistant Professors Caserta and Landeira

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. degree will take related work in a second Romance language; however, related work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

FRENCH

For Seniors and Graduates

209. Advanced Composition and Syntax. A systematic study of the differences between French and English patterns of expression; practice in writing various styles of French. 3 units. *Hull*

210. The Structure of French. Modern French phonology, morphology, and syntax. Readings in current linguistic theory. 3 units. *Hull*

213, 214. French Literature of the Seventeenth Century. First semester: theater. Readings in the dramatic literature of the century. Second semester:

prose and nondramatic poetry. Readings in baroque and *precieux* poetry, the novel and moralists. 3 units per semester. *Staff*

217. French Symbolism. The poetry and theories of Baudelaire, Mallarmé, and Rimbaud. Decadence: Lautreamont and Laforgue. *Fowlie*

219. Old French Literature. An introduction to the reading of Old French literary texts. 3 units. *Vincent*

220. French Pre-Romantic and Romantic Poetry. Chénier, Vigny, Lamartine, Musset, Hugo, and Nerval. 3 units. *Niess*

221, 222. The Nineteenth Century French Novel. First semester: Romanticism and Romantic Realism, studies especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. 3 units per semester. *Niess*

223. Structuralism and the New Criticism. Backgrounds of the New Criticism and its contemporary practice: psychoanalysis (Jung, Freud); archetypes (Bodkin); existentialism (Sartre); myth and ritual (Frazer, Harrison, etc.); structuralism in anthropology (Lévi-Strauss); structuralism in literary criticism (Barthes, Starobinski, Rousset, etc.). To be conducted in English. Readings in English or French. 3 units. *Fowlie*

224. History of the French Language. The evolution of French from Latin to its present form; internal developments and external influences. 3 units. *Hull*

225. French Prose of the Sixteenth Century. Rabelais, Marguerite de Navarre, and Montaigne, and others. 3 units. *Tetel*

226. French Poetry of the Sixteenth Century. A critical appraisal of Villon, Marot, the École Lyonnaise, the Pléiade, and the Baroque Poets. 3 units. *Tetel*

228. French Poetry of the Twentieth Century. In the wake of symbolism; Valéry and Claudel; poetry as ritual, Péguy; Appollinaire and surrealist poetry; the contemporary movement, Michaux, Char, Saint-John Perse. 3 units. *Fowlie*

233. Contemporary French Theater. A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. 3 units. *Fowlie*

234. Proust. A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. 3 units. *Fowlie*

241, 242. French Literature of the Eighteenth Century. First semester: the literature of the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. 3 units per semester. *Stewart*

245, 246. French Literature of the Twentieth Century. First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman*. 3 units per semester. *Cordle*

For Graduates

311, 312. French Seminar. Each semester one of the following topics will be selected for intensive treatment: studies in sixteenth century literature, studies in eighteenth century literature, studies in nineteenth century literature, studies in seventeenth century literature, studies in contemporary literature,

and studies in medieval literature. 3 units per semester. *Cordle, Fowlie, Niess, Stewart, Tetel, and Vincent*

———. **Graduate Reading Course.** An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. No credit.

ITALIAN

For Seniors and Graduates

283. Italian Novel of the Novecento. Representative novelists from Svevo to the most recent writers. 3 units. *Caserta*

284. Dante. *La Vita Nuova* and a close reading of the *Inferno*. Conducted in English. 3 units. *Fowlie*

288. The Renaissance. Petrarch, Boccaccio, and Ariosto. 3 units. *Tetel*

SPANISH

For Seniors and Graduates

251. The Origins of Spanish Prose Fiction. A critical study, based on close readings and discussion, of selected examples of the principal genres of the romance and the novel: the *Amadis de Gaula*, Diego de San Pedro's *La cárcel de amor*, the *Abencerraje*, the *Lazarillo*, Montemayor's *Diana*. 3 units. *Wardropper*

252. Spanish Lyric Poetry Before 1700. A critical study, based on close reading and discussion, of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor, la poesia de tipo tradicional*, and Santillana; on Garcilaso, San Juan de la Cruz, Fray Luis de León, and Herrera; on Góngora and Quevedo. 3 units. *Wardropper*

253. The Origins of the Spanish Theater. A study of the evolution of the Spanish theater from *Auto de los Reyes Magos* (twelfth century) through the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gómez Manrique, Encina, Gil Vincente, Torres Naharro, Lope de Rueda, Juan de la Cueva. 3 units. *Wardropper*

255, 256. Modern Spanish American Literature. First semester: poetry from *Modernismo* to the present. Second semester: twentieth century fiction. 3 units per semester. *Fein*

257. Old Spanish. The historical development of the language together with illustrative readings. 3 units. *Davis*

258. Medieval Literature. An introduction to medieval Spanish texts. 3 units. *Davis or Garci-Gómez*

259. Spanish Phonetics. A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. 3 units. *Predmore*

260. Origins and Development of Spanish Romanticism. Representative authors, including Espronceda, Rivas, Zorrilla, Bécquer, and Rosalia de Castro, with a stress on drama and poetry. 3 units. *Landeira*

261. Nineteenth Century Novel. A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazán, Blasco Ibánez, and their contemporaries. 3 units. *Davis*

262. Galdós. Works selected from the *Novelas contemporaneas*, the *Episodios nacionales*, and his drama. 3 units. *Davis*

265. Cervantes. The life and works of Cervantes with special emphasis on his *Quijote*. 3 units. *Predmore or Wardropper*

266. Drama of the Golden Age. Study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. 3 units. *Wardropper*

275, 276. Contemporary Spanish Literature. First semester: the essay and lyric poetry. A study of the revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester: a study of tradition and innovation in the twentieth century Spanish novel with emphasis on the novels of Unamuno, Baroja, Valle, Inclán, and Pérez de Ayala. 3 units per semester. *Predmore*

For Graduates

321, 322. Hispanic Seminar. Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and Baroque, studies in Spanish poetry, studies in nineteenth century Spanish literature, and studies in twentieth century literature. 3 units per semester. *Davis, Fein, Garci-Gómez, Landeira, Predmore, and Wardropper*

ROMANCE LANGUAGES

218. The Teaching of Romance Languages. Evaluation of objectives and methods; practical problems of language teaching at the elementary, secondary, and college levels; analysis of textbooks, tests, and audiovisual aids; applied linguistics. 3 units. *Hull*

Slavic Languages and Literatures

Associate Professor Krynski, *Chairman* (314 Foreign Languages); Associate Professor Jezierski

The Department of Slavic Languages and Literatures inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

For Seniors and Graduates

201, 202. The Novelists of Nineteenth Century Russia. Development of the Russian novel against the European background, with emphasis on Dostoevsky and Tolstoy. Extensive readings in English. 3 units per semester. *Krynski*

205. The Structure of Polish in Relation to Russian. Comparative and contrastive study of the two major Slavic languages. Considerable emphasis placed on preparing students to read Polish literary texts. 3 units. *Krynski*

206. Readings in Contemporary Polish Prose in the Original. Stylistic

analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski, and short stories by Slawomir Mrozek and Marek Hlasko. 3 units. *Krynski*

207. Soviet Literature and Culture. Literature since 1917. Readings in English from major works of prose, poetry, and drama. 3 units. *Jezierski*

209. Readings in Contemporary Polish Prose in the Original. Stylistic analysis of short prose by Brandys, Rozewicz, Andrzejewski, and others. 3 units. *Krynski*

212. Pushkin. A survey of his life and works, with attention given to his role as a precursor of modern Russian literature. Readings in English or Russian. Prerequisite: Russian 101 or consent of the instructor. 3 units. *Krynski*

213. The Slavs: Literature and Culture, 1918-1939. Study of the culture of the Soviet Union, Poland, and Czechoslovakia using representative literary masterpieces. Comparison with Western European trends. Readings in English. 3 units. *Krynski*

214. The Poles: Literature and Culture, 1940-1970. Study of the culture of Poland using representative literary masterpieces. The international context with emphasis on Western literary avant-garde and Soviet political influences. Special attention to Jewish themes. Readings in English. (Also listed as Comparative Literature 214.) 3 units. *Krynski*

***224. The Russian Short Story—Eighteenth Century to the Present.** Readings of stories by such masters of the genre as Pushkin, Gogol, Turgenev, Tolstoy, Dostoevsky, and Chekhov. Readings in English. 3 units. *Jezierski*

225. Tolstoy. A study of his life and works. The novels, short fiction, plays, and other writings considered in the light of his world significance. Readings in English. 3 units. *Jezierski*

***227. Gogol.** Life and works: short stories, dramas, and the novel. Readings in English or in Russian. 3 units. *Jezierski*

230. Chekhov and the Russian Prose of the Turn of the Century. Structural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, Symbolist, and Decadent trends in Russian prose. 3 units. *Krynski*

232. Dostoevsky. A close examination of his major fiction. Readings in English. 3 units. *Jezierski*

***236. Russian and Polish Romanticism.** Prose, poetry, and drama of such major writers as Pushkin, Lermontov, Mickiewicz, and Krasinski presented against the background of the Romantic movement in Western Europe. 3 units. *Krynski*

Sociology

Professor Kerckhoff, *Chairman* (268 Sociology-Psychology Building); Professor Smith, *Director of Graduate Studies* (332 Sociology-Psychology Building); Professors Back, Maddox, McKinney, Myers, Palmore, Preiss, Roy, and Tiryakian; Associate Professors Simpson and Wilson; Assistant Professors Baldigo, Campbell, Evers, Hirschman, House, and Schneller

*Not offered in 1975-1976.

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Candidates for the Ph.D. degree in sociology are expected to demonstrate in qualifying and preliminary examinations a broad background in the various aspects of sociology—substantive, theoretical, and empirical. The program of each candidate is determined by a committee which reviews his previous work and sets the specific requirements to be met. These requirements will include work in related fields such as anthropology, economics, mathematics, philosophy, political science, or psychology. Emphasis is placed on the completion of the dissertation, directed by a member of the staff, demonstrating competence and independence in the investigation of an original and significant problem.

Further details of this program, the departmental facilities, the staff, and various stipends available may be obtained from the Director of Graduate Studies.

For Seniors and Graduates

225. Medical Sociology. A review and critique of current issues in the organization and development of resources for health care and of factors associated with the utilization of these resources. 3 units. *Back or Maddox*

241. Social Stratification. The nature of hierarchial and vertical differentiation in the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. 3 units. *Campbell, Evers, or Roy*

242. The Sociology of Occupations and Professions. The social significance of work. Analysis of forces changing the contemporary occupational structure, typical career patterns of professions and occupations, the social organization of occupational groups. 3 units. *Simpson*

243. Population Dynamics and Social Change. Introduction to demographic analysis. The relationship between the demographic structure of society and its social organization. 3 units. *Evers or Myers*

251. The Sociology of Modernization. Changes, obstacles to change, and structural strains which occur in kinship, stratification, bureaucracy and the role of the military, occupations and work, communications, and values and ideologies, during modernization. 3 units. *Hirschman or Tiryakian*

255. Race and Culture. A comparative study of race relations in world perspective developed around such themes as races and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. 3 units. *Hirschman or Palmore*

259. Religion and Social Change. A study of the role of religion in significant social changes in Western and non-Western societies. Emphasis given to non-institutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). Prerequisite: Anthropology 264 or Sociology 151, or equivalent. 3 units. *Tiryakian and Wilson*

260. Science, Technology, and Society. Science as a social phenomenon.

Relations of science to technology and their articulation through public policy. Interaction of the institutions of science with other societal institutions. 3 units. *McKinney*

272. The Socialization Process. A consideration of the universal societal requirement for replacement of socialized personnel with major concentration on the process in Western society. Particular attention is given to variations in socialization by position in the social structure (class, caste, urban-rural) and to the contributions made by various socialization agencies (family, school, peer groups, mass media). 3 units. *Kerckhoff*

275. Social Attitudes and Individual Behavior. Such issues as the following are considered: the importance of symbolic interaction, the development of the "self," the social structuring of the socialization process, individual movement within the social structure, and the importance of membership groups and reference groups. 3 units. *Back or House*

278. Social Structure and the Life Cycle. A study of the relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. 3 units. *Maddox*

295. Methodology in Sociology. Considerations of the nature of scientific method, as well as alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation both on the general level of research design and the specific level of special techniques. The process and logic of data analysis. Relations of theory to research are stressed. 3 units. *Back or Smith*

297. Introductory Statistical Analysis. Basic descriptive statistics, regression and correlation, t-tests and the analysis of variance, chi square techniques and other topics. Stress on practical applications. Extensive exercises in statistical computing using SPSS and other programs. 3 units. *Campbell*

298, 299. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. 3 units each course. *Staff*

For Graduates

301. Seminar in Human Fertility. Special topics in human fertility including: theory of demographic transition, fertility in Latin America, design and evaluation of family planning programs, fertility and problems of modernization, and family structure and fertility. 3 units. *Back*

302. Seminar in Migration. Special topics in migration including: Latin American rural-urban migration, urban migration policy, contemporary migration theories, and international migration. 3 units. *Myers or Smith*

325. Social Aspects of Mental Illness and Treatment. An examination and critique of sociological research and theory in the epidemiology, etiology and treatment of mental illness. Such topics as the effect of mental illness on the family, the structure and function of various treatment systems and major problems of methodology will receive emphasis. 3 units. *Back or Preiss*

341. Special Problems of Complex Systems. (*a*) *Industrial and Professional Systems.* Analysis of problems of organization of work in such diverse settings as industrial plants, hospitals, and public administration groups. Problems of decision-making, recruitment, allocation of authority, informal organization, inter-organizational relations. 3 units. *McKinney or Roy*

(*b*) *Mass Communications.* Theoretical problems in defining and distinguishing communication, communicative acts, communication processes, and

communication systems. Work aimed toward the derivation of models and theories for each of these will be pursued. Students must have permission of the instructor. 3 units. *Smith*

(c) *Urban Society.* Analysis is made of the varying mechanisms through which urban society is integrated, how urbanites develop a sense of identification with the community, and the extent and mode of social dominance of the city in the larger society. 3 units. *Myers or Smith*

(d) *Human Ecology.* An examination of such issues as the logic and utility of the ecological approach; the possibility of testing current ecological theories in non-Western, non-urban environment; alternative explanations for the spatial patterning of social phenomena; selected methodological problems. 3 units. *Myers or Smith*

344. Workshop on Computer Models of Social Systems. The methodology of building mathematical and logical models of social systems and computer simulation experiments with such models. The types of models and social systems surveyed have applications in business administration, economics, education, political science, psychiatry, psychology, and sociology. Participants in the workshop will develop and conduct simulation experiments with a model of some complex social system, such as a city, state, region, or nation. 3 units. *Naylor*

345, 346. Demographic Techniques I and II. Measurement and methodology in demography. The first course will deal primarily with basic measurement techniques including standardization, construction of the life table, period and cohort measures of fertility, and introduction to classical population theory. The second will be devoted to the analysis of complex models such as family building models and growth and projection models and the preparation of a research topic. 3 units per semester. (Also listed as Economics 345, 346.) *Evers or Myers*

351, 352. Seminar in Social Organization. Examination of such problems as the bases of social cohesion and continuity, the sources and effectiveness of social control mechanisms, the problem of social change in structural-functional theory. 3 units per semester. *Maddox and McKinney*

361. Seminar in Comparative Sociology. Major emphasis on the relevance of evolutionary, functional, and structural theories for explaining the findings of comparative studies. 3 units. *Hirschman, Myers, and Smith*

373, 374. Social Psychological Issues in Sociology. Detailed exploration of selected problem areas such as the theory and measurement of social attitudes, role discontinuity and personality disorders, applications of reference group theory, the socialization process. 3 units per semester. *Back, House, Kerckhoff, and Preiss*

381. Development of Sociological Theory. An analysis of the development, convergence, and utilization of sociological theory. 3 units. *McKinney, Tiryakian, or Wilson*

385. Seminar in Sociological Theory. Analysis of methodological and substantive problems in utilizing comprehensive, middle-range, and discrete theories in varied sociological areas. Major emphasis on the use of theory in empirical research. Prerequisite: Sociology 381 or equivalent. 3 units. *McKinney and Tiryakian*

386. Seminar in Sociological Theory. Focuses on the theoretical and research implications of existential phenomenology, drawing from such sources

as Husserl, Merleau-Ponty, and Schutz. Attention will be given to recent sociological interests in this area (e.g., ethnomethodology). Prerequisite: Sociology 381 or equivalent. 3 units. *Tiryakian*

390. Seminar in Field Methods of Sociological Research. The primary aims of this course will be two-fold, (*a*) to consider at length and in detail various procedures and problems of observing human behavior in natural group, organizational, and community settings, and (*b*) to give the neophyte researcher elementary training in first-hand observation and face-to-face interviewing. 3 units. *Roy or Schneller*

392. Individual Research in Sociology. Students will conduct on an individual basis research designed to evaluate a sociological hypothesis of their choice. The process must be completed by preparation of a report on this research in adequate professional style. Prerequisite: Sociology 295 or permission of the instructor. 3 units. *Back or Smith*

397, 398. Seminar in Special Research Problems. Treatment in depth of either selected methodological issues and/or methods. Examples of possible topics including scaling, methods of machine data processing, validation and induction, theory construction, quantification, interviewing, measurement, sampling plans, development of research designs from statistical models, methodological research, experimental techniques, demographic techniques, the relation of theory to research, and the role of statistical methods in sociology. Prerequisite: permission of instructor. 3 units each semester. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

Zoology

Professor Fluke, *Chairman* (227 Biological Sciences Building); Associate Professor Wainwright, *Director of Graduate Studies* (024 Biological Sciences Building); Professors Bailey, Bookhout, Costlow, Gillham, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, Tucker, and K. Wilbur; Associate Professors Barber, Vogel, and Ward; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Bergeron, Forward, Lundberg, McClay, Storey, Sutherland, and H. Wilbur

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology

and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For Seniors and Graduates

201. Animal Behavior. Emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics, and evolution, or consent of instructor. Usually taught on a tutorial basis. 3 units; 4 units with laboratory. *Klopfer or Rosenson*

202. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lectures and laboratory. Prerequisite: one course in physiology. Given at Beaufort. 6 units. *Salmon*

203. Marine Ecology. Ecological processes as exemplified by marine organisms; environmental factors, intra and interspecific relationships; community ecology. Readings, discussion, written papers, and computer use. Field projects using modern methods. Prerequisites: a course in general biology, invertebrate zoology or the equivalent, and a year of mathematics; some knowledge of statistics would be helpful. Given at Beaufort. 6 units. *Sutherland*

204. Population and Community Ecology. Theoretical ecology emphasizing the evaluation of life cycles, mathematical properties of systems of interacting species, and mechanisms of species interactions. Laboratories emphasize biometrical and experimental testing of ecological theory in relation to a variety of habitats. Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus, senior or graduate standing, or permission of instructor. 4 units. *H. Wilbur*

205. Elements of Theoretical Biology. An introduction to elementary mathematical biology, conceived as the study of axiomatized mathematical theories and their biological models. Prerequisites: introductory college biology and mathematics, or consent of instructor. 3 units. *Gregg*

214. Biological Oceanography. Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Shipboard investigations of the biological productivity of the continental shelf ecosystem. Prerequisite: permission of instructor. 6 units. *Barber*

216. Limnology. A study of lakes, ponds, and streams, including their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities living in them. Lectures, field trips, and laboratory work. Usually offered in alternate years. Prerequisites: introductory college biology, chemistry, physics, and Mathematics 31, or permission of instructor. 3 units; 4 units with laboratory. *Livingstone*

218. Paleobiology. Readings, discussions, and lectures on the dynamics of past ecosystems; climatology and ecological geography of the past few million years; laboratory study of lake beds with emphasis on Quaternary pollen grains. Prerequisites: consent of the instructor and a course in ecology. 4 units. *Livingstone*

224. Vertebrate Zoology. A study of life histories, adaptations, ecology, and classification of vertebrate animals. Prerequisite: Zoology 56. 4 units. *Bailey*

229. Morphogenetic Systems. Lectures on the interplay of theory and experiment in twentieth century developmental biology. Prerequisite: introductory biology. 3 units. *Gregg*

235. Evolutionary Systematics. Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Prerequisite: college biology. Laboratory optional. (Also listed as Botany 235.) 3 or 4 units. *Bailey, Lundberg, or Stone (Botany)*

236. Human Genetics. See course description for Anatomy 236. (Also listed as Anatomy 236, Anthropology 236, and under the Genetics Program.) 3 units.

238. Systematic Zoology. The fundamental theory and practice involved in the collection, identification, and classification of animals. Prerequisite: college biology. 4 units. *Bailey*

239. Biogeography. Seminar. Old and new distributional concepts of animals and plants involving physical geography, geology, paleontology, systematics, evolution, population dynamics and dispersal. Prerequisite: permission of the instructor. 3 units. *Bailey*

245. Radiation Biology. Actions of ionizing and excitational radiations on life processes; biological use of radioactive tracers; nucleonics. Prerequisites: college physics, mathematics, and chemistry. 3 units; 4 units with laboratory. *Fluke*

246. Physical Biology. Topics involving the physical basis of living organisms and systems, such as physical optics and biomechanics, and application to functions at higher levels of organization. Prerequisites: college mathematics, chemistry, physics, and one biology course beyond the introductory course, or consent of instructors. 3 units. *Fluke and Wainwright*

248. Introductory Biochemistry. For description, see Biochemistry 247. (Also listed as Biochemistry 247 and Botany 248.) 3 units. *Siegel (Biochemistry)*

250. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) 6 units. *Forward*

252. Comparative Physiology. The physiological mechanisms of animals studied on a comparative basis. Prerequisite: Zoology 151 or equivalent. 4 units. *Schmidt-Nielsen*

254. Fluid Flow and Living Systems. Seminar. Physical principles of low speed flow; applications to locomotion, circulation, dispersal, ventilation, filtration, and heat dissipation. Prerequisites: college physics and Mathematics 31 or equivalent. 3 units. *Vogel*

258. Laboratory and Research Methods. Radioisotope methods, spectrophotometry, light microscopy, transmission and scanning electron microscopy, X-ray diffraction, gel electrophoresis, isolation of cell components, and other methods. Students may select methods according to their interests and research needs. Prerequisite: consent of the instructor. Credits to be arranged. 1-4 units. *K. Wilbur or Staff*

260. Advanced Cell Biology. Structural and functional organization of cells and their components emphasizing current research problems and prospects. Prerequisites: introductory cell biology or genetics with permission of instructor; introductory biochemistry recommended (may be taken concurrently). 3 units. *Nicklas, K. Wilbur, or Staff*

262. Cytological Materials and Methods. General cytological analysis, with emphasis on chromosome studies using current optical, cytochemical, and experimental techniques. Prerequisite: Zoology 160 or 260 or equivalent (may be taken concurrently). 2 units. *Nicklas*

265. Seminar in Chromosome Biology. Current research on chromosome structure and function, mitosis and meiosis. Prerequisites: a course in cell biology or genetics and permission of instructor. (Also listed as Anatomy 265.) 2 units. *Moses (Anatomy) and Nicklas*

266. Seminar in Chromosome Biology. Same as 265. Prerequisites: a course in cell biology or genetics and permission of instructor. (Also listed as Anatomy 266.) 2 units. *Moses (Anatomy) and Nicklas*

274. Marine Invertebrate Zoology. Structure, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips will be made to study, collect, and classify animals in their natural habitats. Prerequisite: college biology. (Given at Beaufort.) 6 units. *Staff*

275. Invertebrate Zoology. Lectures, readings, and laboratory work dealing with free-living and parasitic invertebrates. Field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174 or 274. Prerequisite: college biology. 4 units. *Bookhout*

277. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism and other aspects of physiology of marine animals, primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) 6 units. *Hagadorn*

278. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. (Given at Beaufort.) 6 units. *Bookhout*

280. Principles of Genetics. See course description for Botany 280. (Also listed as Botany 280 and under the University Program in Genetics.) 3 units. *Boynton (Botany), Gillham, and Others of the University Program in Genetics*

286. Evolutionary Mechanisms. Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Prerequisite: college biology. (Also listed as Botany 286 and under The University Program in Genetics.) 3 units. *Antonovics (Botany) and H. Wilbur*

286L. Evolutionary Mechanisms. Same course as 286 except laboratory included. 4 units. *Antonovics (Botany), Lundberg, and H. Wilbur*

288. Seminar on the Role of the Cell in Development and Heredity. (Also listed as Anatomy 288.) 2 units. *Counce (Anatomy)*

295, 296. Seminar. Topics, instructors, and course credits announced each semester. 1-3 units. *Staff*

For Graduates

351, 352. Departmental Seminar. A weekly meeting of graduate students and faculty to hear and discuss research reports. 1 unit credit by arrangement. *Staff and Invited Lecturers*

353, 354. Research. To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*

355, 356. Seminar. One or more seminar courses in particular fields are given each semester by various members of the staff. These will be in the fields indicated in Zoology 353, 354. 2 units. *Staff*

360, 361. Tutorials. Students will write essays based on reading of literature. Essays will be discussed and critically evaluated in meetings. 2 units per semester. *Staff*

Genetics, The University Program. Genetics courses offered by the Department of Zoology are part of The University Program in Genetics; see announcement in this *Bulletin*.

Marine Laboratory. The following courses are given at Duke University Marine Laboratory, Beaufort, N. C.: 202, Phytoplankton Systematics; S202, Introduction to Comparative Behavior; 203, Marine Ecology; 204, Marine Microbiology; 205, Geological Oceanography; 211, Marine Phycology; 212, Membrane Physiology and Osmoregulation; 214, Biological Oceanography; 230, Chemical Pollution of Coastal Waters; 240, Chemical Oceanography; 250, Physiological Ecology of Marine Animals; 274, Marine Invertebrate Zoology; 276, Comparative and Evolutionary Biochemistry; 278, Invertebrate Embryology. Consult Marine Sciences in this *Bulletin* for other offerings at the Duke University Marine Laboratory.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Latin America. Refer to the section Organization for Tropical Studies in this *Bulletin* in the chapter on Special and Cooperative Programs.

Appendix

ADVANCED DEGREES CONFERRED MAY 12, 1974

Master of Arts

Afuwape, Anthony Uyi Abayomi
Atkinson, Margaret Livingston
Bebensee, Mark Alan
Berning, John Albert, Jr.
Bhattacharya, Lybia Soedjono
Bolick, Margaret Ruth
Chesney, Elizabeth Anne
Clarke, Margaret Hess
Claudy, Carolyn Carruth
Cohen, Jo-Ann Deborah
Cohen-Cole, Steven Arnold
Conrad, Dennis M.
Cool, Kenneth Eugene
Collidge, Sharon Ann
Cooper, Lynne Allison
Covi, Madeline Cundiff
Cox, Diane Steiger
Davidson, Maurine Jo
Davenport, George William
DeHaven, Dara Lyn
Dill, Clara Maria
Dishman, Harriet Grooters
Doty, Rodney
Economou, Alene Delgado
Estes, Kenneth William
Fairfax, Sally Kirk
Fergusson, Thomas Galloway
Firpi, Alejita
Gilchrist, John Tyson
Goldman, Robert Lawrence
Gravatt, Brent Leigh
Gruenewald, Christopher Irvin
Guilmart, Kenneth L.
Herren, Robert Stanley
Ibrahim, Ibrahim Abdes-Salam
Jackson, Louis Myles
Jakoi, Laszlo
Johnson, Sam Bishop
Johnston, Allan John
Kasurak, Peter Charles
Kaufman, Ann Susan
Ko, Benny Ping-Nam
Lacey, David Morgan
Larsen, Kenneth Edward
Lauf, Waltraud Rieger
Lee, Hsuan-Pei
Lorber, Charles M.
Mahler, Gregory Steven
Maungmuensuk, Praput
McCorquodale, Ann
McKay, Lawrence Edward, Jr.
McKenney, Janice Emery
Mendez, Adriana
Moeller, John Erwin
Mulvey, William Lee
Muzik, Katherine Margaret
Nichols, Douglas Jefferson
Paddock, Alfred Harlan, Jr.
Parker, Lucy Marie Ellis
Pearson, Harlan Otto
Peck, Michael Patrick
Rogers, Joe O'Neal, Jr.
Rowe, William John
Rusnak, Joseph Gary
Sage, Nancy Elizabeth Wells
Scales, Robert H., Jr.
Schwier, David Richard
Shelburne, Brian James
Shepherd, Wade Keever
Sinski, Diane Marilyn
Snyder, Elizabeth Ann
Spurling, Norman Kent
Staats, Steven John
Strunks, Emily Jo
Vaughan, Thomas Ronald
Waide, Stanley John, Jr.
Wendland, John Charles
Wiener, Sharon Anderholm
Williams, Richard Frank
Young, Brodie Anderson
Zais, Barrie Emert
Zekan, Patricia Joan
Zuckerman, Susan Lana

Master of Arts in Teaching

Bolton, Thomas Cornish, III
Feifs, Helmuts Andris
Frentz, Barbara T. DiNubile
King, Kathy Keith
Kiontke, Christine Anne
Loving, Cathleen Creighton

Master of Education

Andrews, Michael Allen
Brauner, Carolyn Rex
Bredenberg, Gladys Ellis
Burch, Peter Reginald
Carlton, Mary MacNeill
Carmalt, Elizabeth Platt
Cavallo, Kathleen Novak
Horton, Patricia Meryl
Humphreys, John Milton
Kaalund, Jacqueline Disch
Kadar, Karen Rose
Parks, Mary Fisher
Speidel, Ellen Early
Triplett, Suzanne Elaine
Vosburgh, Marian Weems
Ward, Lucia Antoinette
Westpheling, Ernest David
Winkle, Linda Wyrick

Master of Science

Allison, John Andrew, IV
Anderson, Gary M.
Apps, David John
Bailey, Albert Eugene, Jr.
Berry, Michael Arnold
Burdett, Ray Gilbert
Burns, William Wesley, III
Burton, Larry Weldon
Colberg, Peter Michael
Costa, Janet Louise
Davis, James Wilkinson
Diecchio, Richard Joseph
Donaldson, Barbara
Donelan, William Joseph
Douglas, William Johnson
Dozier, Jack Curtis
Dubbé, Roland Everette
Dunlevy, Harvey Risher
Fragaszy, Richard J.
Frontiero, Paul A.
Gnepp, Douglas Robbin
Goldston, Chesley Slyvester, II
Gross, Charles Haskell
Hamilton, Paul Lawrence
Hribernik, Robert Martin
Jackson, Marianne
Jett, Tedd Hunter
Johnson, Duane Gordon
Keever, Robert Cebe
Korzon, Leonard Paul
Livermore, Joanne Eileen
Lyon, Robert B., Jr.
McAuliffe, Kathleen
McCullers, Stephen Dale
Molbert, John Lee
Nuckols, Marshall Llewellyn

Olshinski, John Albert
Owens, James Sherman
Paschal, Karen Anne
Posey, Lucile Kathleen
Rapp, Sylvia Jo
Ridella, John Stephen
Rivers, Charles Silas, Jr.
Ross, Michael Alan
Rouse, William Francis
Schock, Daniel Rolland, III
Schroeder, R. Ames
Selker, Leopold George
Skuchas, Edward George
Stephens, John Scott
Tanabe, Eiji
Vatis, Dimitrios
White, Barry Lane
Wicken, Allen William
Zusin, Edmund Charles

Master of Business Administration

Alford, James David
Angwenyi, Jimmy Nuru Ondieki
Bentson, Steven Roy
Boon, Marshall Murry
Brochick, George William
Burkhead, Eric Milton
Daniels, Bryant Rex
Dermer, Daniel Jay
FitzHugh, Cary Grayson
Fyfe, Charles R., Jr.
Hammarsten, Richard Anders
Harrington, Daniel John
Hemink, Duncan Lawrence
Hooper, Jerry Alexander
Jamerson, Robert Lee, Jr.
Joye, Arthur Edward
Lam, Chun Hung
Langdon, Stewart Douglas
Nicholson, John Hancock, III
Parisi, John Charles
Pritchard, James Lee
Radecki, Richard Lee
Roberts, Jerry Eugene
Roller, Thomas Benjamin
Ross, Henry Steven
Ruth, Josef Karl
Seymour, Richard Allen
Siewers, Dean Charles
Simpson, Walter Willis, III
Southerland, Sydney Duane, Jr.
Ulrich, Wesley Alan
Walther, William E.
Weldon, Peter Jones
Williamson, James Thomas
Wright, Gary Lee

Master of Health Administration

Barragan, J. Bruce
Beutell, William Charles
Bullock, Scott Baxter
Butler, Ronald James
Clark, James Robert
Cousineau, Pierre
Frock, Charles Thomas
Grant, Patrick, Jr.
Harrison, Edwin Thomas
Henson, David Leslie
Hillenmeyer, John Wharton
Holly, John Durwood, III
Johnson, Terrence Lynn
Mahoney, Jane Ann
Nettles, William Edward
Northrop, Thomas Webster
Quintana, Jose Booth
Ryerson, Frank Earl
Stanko, John Richard
Tumey, Lincoln Edward
Valimahomed, Salim Akbarali
Vinsel, Douglas Bryce
Wall, James Arthur, Sr.
Wolarsky, Joel Michael

Doctor of Education

Comer, Stephen Wray (A.B., A.M., Wake Forest University). *Education.* Dissertation: "Contributions of Howard E. Wilson to Education for Citizenship and International Understanding."

Hagan, Robert Douglas (A.B., University of Missouri; M.Ed., Duke University). *Education.* Three articles were submitted in lieu of a dissertation.

Hawkins, Gerald Gordon (B.S., North Carolina State University; M.S., Indiana University). *Education.* Dissertation: "A Conceptual Model for an Experiential Freshman Development Program at North Carolina State University."

Kollar, Joseph Blaine, Jr. (B.S., Miami University; A.M., Appalachian State University). *Education.* Dissertation: "Judicial Opinions Involving Public Funds or Services for Nonpublic Elementary and Secondary Schools."

Lancaster, Tryon Delano, Sr., (B.S., A.M., East Carolina University). *Education.* Dissertation: "A Study of the Qualifications and Duties of Directors of Instruction Identified by the Superintendents in North Carolina."

Long, Betty Mobley (B.S., A.M., East Carolina University). *Education.* Dissertation: "Utilization of a Synthetic Multisensory Modality of Teaching Spelling Emphasizing Dactylology to Test Its Effect on Reading and Spelling Achievement."

McIntosh, James Wylie, Jr. (B.S., Carson-Newman College, M.S.P.H., University of North Carolina, M.S., Oregon State University). *Education.* Dissertation: "Teaching Seventh Grade Life Science Through Quantitative Operations."

Moore, Elizabeth H. (L.L.B., University of Louisville; M.Ed., University of Florida). *Education.* Dissertation: "Parental and Teacher Understanding of Emotionally Disturbed Children."

Rush, Laird Loraine (A.B., Bridgewater College; M.Ed., University of Virginia). *Education.* Dissertation: "The Newspaper and Its Effect on Support of Public Education in Selected School Divisions in the State of Virginia."

Saunders, Alan Harvey (B.S., Virginia Polytechnic Institute; M.Ed., University of North Carolina). *Education.* Dissertation: "Reverse Transfer—A Second Challenge to the Salvage Claims of the Community College."

Schurrer, Roger Arthur (B.S., A.M., East Carolina University). *Education.* Dissertation: "Operational Planning Model for Local School Systems in North Carolina."

Settle, Joseph C. (B.S., Winston-Salem State University; A.M., North Carolina Central University). *Education.* Dissertation: "A Study of Alternative Roles and Patterns for Two Small Private Black Church-Related Colleges in North Carolina."

Sutton, Annie Mae J. (A.B., Atlantic Christian College; A.M., East Carolina University). *Education.* Dissertation: "The Teachings of the Language Arts in the Elementary School."

Doctor of Philosophy

Alberte, Randall Sheldon (A.B., Gettysburg College). *Botany.* Dissertation: "Development of the Photosynthetic Apparatus in Greening Leaves."

Alpay, Bilal Inan (B.S., Robert College; M.S., Duke University). *Civil Engineering.* Dissertation: "On Response of Initially Stressed Structures to Random Excitations."

Atencio, Frank William (A.B., University of California). *Psychology.* Dissertation: "The Effects of Occipital, Temporal and Parietal Lesions on Visual Discriminations in a Prosimian Primate, *Galago senegalensis.*"

Bagnal, Whitney Scofield (A.B., Wells College). *Classical Studies.* Dissertation: "The Archive of Laches: Prosperous Farmers of the Fayum in the Second Century."

Bozeman, Theodore Dwight (A.B., Florida Presbyterian College; B.D., Th.M., Union Theological Seminary). *Religion.* Dissertation: "Baconianism and the Bible: The Baconian Ideal in Ante-Bellum American Presbyterian Thought."

Brannan, Emora Thomas (A.B., Johns Hopkins University; B.D., Drew University). *Religion.* Dissertation: "The Presiding Elder Question: Its Critical Nature in American Methodism 1820-1824 and its Impact upon Ecclesiastical Institutions."

Breytspraak, William August (A.B., Southwestern at Memphis; M.Div., Duke University). *Religion.* Dissertation: "Toward a Post-Critical Sociology of Knowledge: A Study of Durkheim, Mannheim, Berger, and Polanyi."

Briggs, Gary Grant (A.B., Hamilton College). *Psychology.* Dissertation: "The Effects of Cerebral Organization on the Control of Fine Movements."

Brine, George Atkins (A.B., University of the South). *Chemistry.* Dissertation: "Synthetic Approaches to Bridged Biphenyls Containing Medium-Sized Rings."

Broome, Carmen Rose (B.S., University of Miami; A.M., University of South Florida). *Botany.* Dissertation: "Systematics of *Centaurium* (Gentianaceae) of Mexico and Central America."

Bropleh, Nah-Doe Patrick (B.Sc., University of Liberia; M.F., Oregon State University). *Forestry.* Dissertation: "Rural Resources and Liberian Economic Development."

Campbell, Edwin Colin (A.B., Gonzaga University; A.M., University of Alberta). *Political Science.* Dissertation: "Appointees to Public Office: The Case of Canadian Senators."

Campbell, Robyn Moore, Jr. (B.S., San Diego State College; M.S., George Washington University). *Political Science.* Dissertation: "Military Command Liability for Grave Breaches of National and International Law: Absolute or Limited?"

Carnevale, Nicholas Theodore (B.S., University of Arizona). *Physiology and Pharmacology.* Dissertation: "Voltage Clamp Analysis of the Slow Oscillations in Bursting Neurons Reveals Two Underlying Current Components."

Chapman, Carol Ann (A.B., Pomona College). *Economics.* Dissertation: "The Impact of Federal Procurement on the IBM-Compatible Memory Equipment Markets."

Chestnut, Paul Ivar (A.B., Duke University; B.D., Yale University). *History.* Dissertation: "The Universalist Movement in America, 1770-1803."

Cochran, Judith Pfau (A.B., Smith College; A.M. Duke University). *Romance Languages.* Dissertation: "*Entretien de Pascal et Sacy sur Epictete et Montaigne*: Montaigne's Influence on the Pascal of 1655."

Costanzo, Frances Simone (A.B., Queen's College; M.Ed., University of Florida). *Education.* Dissertation: "Linguistics and Grammar Instruction: A Model for Developing 'Educational Linguistics'."

Cowgell, Virginia Gutman (A.B., Stetson University). *Psychology.* Dissertation: "Responding to Suicidal Communications."

Crow, Jeffrey J. (A.B., Ohio State University; A.M., University of Akron). *History.* Dissertation: "Maverick Republican in the Old North State: The Governorship of Daniel L. Russell, 1897-1901."

Culpepper, Richard Alan (A.B., Baylor University; M.Div., Southern Baptist Theological Seminary). *Religion.* Dissertation: "The Johannine School: An Evaluation of the Johannine-School Hypothesis Based on an Investigation of the Nature of Ancient Schools."

Cunningham, William Gerard (B.S., Miami University; M.B.A., Bowling Green University). *Education.* Dissertation: "The Impact of Student/Teacher Pairings on Student Performance."

Damgaard, Jacqueline Ann (B.S., University of Wisconsin). *Psychology.* Dissertation: "Structured Versus Unstructured Procedures for Training Groups in the Expression of Feeling-Cause Relations."

de Groof, Robert Clifford (B.S.E.E., University of Florida). *Physiology and Pharmacology.* Dissertation: "The Effects of the Marine Toxin Holothurin A on Squid Axon Membrane."

de Montluzin, Emily Lorraine (A.B., Newcomb College; A.M., Duke University). *History*. Dissertation: "Jacobinism and the Reviewers: The English Literary Periodicals as Organs of Anti-Jacobin Propaganda."

Dessent, Thomas A. (B.S., West Virginia Wesleyan College; A.M., Duke University). *Chemistry*. Dissertation: "Specular Reflectance and Derived Optical Constants of Some Highly-Absorbing Transition-Metal Complexes."

Dhar, Sachidulal (B.Sc., M.Sc., University of Dacca). *Physics*. Dissertation: "A Study of $\pi\pi$ Interaction and N* Production in High Energy π^-p Collisions."

Drinnan, Carol Van Atta (A.B., Rice University; M.S., Lamar State College). *Chemistry*. Dissertation: "I. Cyclization of Derivatives of 2-*exo*-phenyl-bicyclo (2.2.1) Heptene-3-*endo*-carboxylic Acid. II. Solvolysis of 4-oxatricyclo(5.2.1.0.^{2,6}) Dec-8-*exo*-yl Methanesulfonates."

Eisenman, Leonard Max (A.B., Brooklyn College; A.M., Miami University). *Psychology*. Dissertation: "Neural Encoding of Sound Location: An Electrophysiological Study in Auditory Cortex (Al) of the Cat Using Free Field Stimuli."

Epanchin, Alexis (B.S., M.Ed., Duke University). *Education*. Dissertation: "The Effect of Alternate Scoring Methods on Predictive Efficiencies for the Kuder Occupational Interest Inventories Used with Engineers."

Fairfax, Sally Kirk (A.B., Hood College; A.M., New York University; A.M., Duke University). *Political Science*. Dissertation: "Federal - State Cooperation in Outdoor Recreation Policy Formation: The Case of the Appalachian Trail."

Falcone, David J. (A.B., Duke University; A.M., Arizona State University). *Political Science*. Dissertation: "Legislative Change and Output Change: A Time-Series Analysis of the Canadian System."

Featherman, Sidney Isaiah (B.Sc., McGill University). *Chemistry*. Dissertation: "A Multinuclear (^{1}H, ^{31}P, ^{13}C) Magnetic Resonance Approach to the Structure of Isomeric 4-Phosphorinanols and the Conformational Analysis of Phosphorinanes."

Fishman, Ethan M. (A.B., A.M., Harpur College). *Political Science*. Dissertation: "Reform: The Popularization and Politicization of Judaism."

Fitzgerald, Bruce David (B.S., M.S., Georgia Institute of Technology). *Economics*. Dissertation: "Voluntarism, Conscription, and the Likelihood of War."

Flynn, Barbara Wilmot (A.B., A.M., Duke University). *History*. Dissertation: "The Communalization of Politics: National Political Activity in India 1926-1930."

Fong, Anne Curtiss (A.B., Barnard College; A.M., University of Hawaii). *Romance Languages*. Dissertation: "Exis and Praxis: Women's Dilemma in the Works of Simone de Beauvoir."

Foster, Robin Bradford (A.B., Dartmouth College). *Botany*. Dissertation: "Seasonality of Fruit Production and Seed Fall in a Tropical Forest Ecosystem in Panama."

Gilbert, William Henry (A.B., Washington and Lee University; A.M., Duke University). *English*. Dissertation: "Browning's *Pauline:* The Case for Shelley's Influence."

Godbey, John William, Jr. (A.B., New School for Social Research). *Philosophy*. Dissertation: "Mental Images and Imaging Experiences."

Goscin, Lee Alice (B.S., University of Florida). *Biochemistry*. Dissertation: 'Hydroxyurea-Sensitive Mutants of Bacteriophage T4."

Goscin, Stephen André (A.B., Princeton University). *Biochemistry*. Dissertation: "Studies of the Role of Superoxide Dismutase and Superoxide Radicals in Hydroxylation Reactions and in Radiation Lethality."

Graham, Thomas Carr, II (B.S., D.V.M., Tuskegee Institute). *Pathology*. Dissertation: "A Study of Myocardial Lesions in Dogs Subjected to Hemorrhagic Shock."

Grandis, Arnold Stephan (B.S., Washington and Lee University). *Biochemistry*. Dissertation: "Membrane Associated DNA Synthesis in fl Bacteriophage Infected *Escherichia coli*."

Greeman, Elizabeth Dix (A.B., Alverno College; A.M., Duke University). *History*. Dissertation: "Stephen A. Douglas and Herschel V. Johnson: Examples of National Men in the Sectional Crisis of 1890."

Gunsburg, Jeffery Albert (A.B., University of Wisconsin; A.M., Duke University). *History*. Dissertation: " *'Vaincre ou Mourir'*: The French High Command and the Defeat of France, 1919 - May, 1940."

Hagen, Edward Christopher (B.S., Boston University). *Physics*. Dissertation: "A Study of Electro-Magnetic Transitions in ^{38}Ca."

Haines, Evelyn Brown (B.S., Emory University). *Zoology*. Dissertation: "Processes Affecting Production in Georgia Coastal Waters."

Hardy, Douglas Lee (A.B., Tufts University; A.M., Duke University). *Economics*. Dissertation: "The Distribution of Automobiles in the United States and Japan."

Harris, John Colin (A.B., Mercer University; M.Div., Southeastern Baptist Theological Seminary). *Religion*. Dissertation: "The Theology of Martin Luther King, Jr."

Hedlin, Ethel Wolfskill (A.B., Radford College; A.M., Duke University). *History*. Dissertation: "Earnest Cox and Colonization: A White Racist's Response to Black Repatriation, 1923-1966."

Hollyday, Margaret Anne (A.B., Swarthmore College). *Physiology and Pharmacology*. Dissertation: "Reflex Specificity from Supernumerary Limbs of *Zenopus Laevis*: The Potential Role of the Periphery in the Determination of Reflex Connections."

Honhart, Carol Taplett (A.B., Carleton College; A.M., Duke University). *English*. Dissertation: "Fielding, Smollett, Sterne, and the Development of the Eighteenth-Century Travel Book."

Huber, Peter Birkett (A.B., Bucknell University). *Anthropology*. Dissertation: "Identity and Exchange: Kinship and Social Order Among the Anggor of New Guinea."

Hughes, Charles Sanders, II (B.S., Clemson University; M.S., Ohio State University). *Electrical Engineering*. Dissertation: "Programmable Cellular Arrays with Internal Feedback and Memory."

Hutton, James David (A.B., Rice University; A.M., Duke University). *Physics*. Dissertation: "Properties of γ-Ray Transitions in ^{33}S and ^{35}S."

Ismael, Nabil Fathy (B.Sc., Cairo University; M.S., Duke University). *Civil Engineering*. Dissertation: "Effect of Compressibility on the Ultimate Bearing Capacity of Shallow Foundations."

Jakoi, Emma Raff (B.S. Washington State University). *Physiology and Pharmacology*. Dissertation: "Cycle Dependent RNA Synthesis and RNA Polymerase Activity of *Tetrahymena Pyriformis* (HSM)."

Johns, Roger Dick (A.B., Centenary College; M.Div., Drew University). *Religion*. Dissertation: "Man in the World: The Political Theology of Johannes Baptist Metz."

Johnson, Carl Anderson (A.B., Duke University). *Psychology*. Dissertation: "The Effects of Personal Control on Stimulus Expectations."

Johnson, James Robert (B.S., Auburn University). *Biochemistry*. Dissertation: "Isolation and Characterization of Mutants of Bacteriophage T4 Resistant to Folate Analogs."

Johnston, Daniel (B.S.E.E., University of Virginia). *Biomedical Engineering*. Dissertation: "The Functional Architecture of Lateral Inhibition in the *Limulus* Retina: A Study Based on Nonlinear Inhibitory Coupling."

Jones, Constance McCulloch (A.B., Mount Holyoke College; A.M., Duke University). *History*. Dissertation: "Crisis of Parlimentary Liberalism: Extremism in Britain in the 1930's."

Joshi, Vinaya (B.Sc., Panjab University). *Physics*. Dissertation: "Nuclear Rotational Bands Generated by Quadrupole Operators."

Kaba, Richard Andrew (B.S., Clemson College). *Chemistry*. Dissertation: "An Electron Paramagnetic Resonance Study of Transient Free Radicals in Solution."

Keiser, R. Melvin (A.B., Earlham College; B.D., S.T.M., Yale Divinity School; A.M., Harvard University). *Religion*. Dissertation: "Recovering the Personal: The Logic of Religious Discourse in the Theological Quest of H. Richard Niebuhr."

Kelly, John Thomas, Jr. (A.B., Catholic University; A.M., Case Western Reserve University). *English*. Dissertation: "Pope and the Poetics of the Ideal: Mimesis in Pope's Versions of Original Sources."

Kessler, Dale LeRoy, Jr. (A.B., Dartmouth College; M.D., Duke University). *Biochemistry*. Dissertation: "The Chemistry and Biology of Sulfite Oxidase."

Kitchell, Barbara Sandra Bielaski (A.B., Goucher College; M.S., Indiana University). *Chemistry*. Dissertation: "Physical Studies of Bacteriophage F-2 Capsids: An Example of a Multiunit Protein System."

Knutton, Sara Parkey (B.S., Rollins College; A.M., Duke University). *Chemistry*. Dissertation: "Theoretical Prediction of Protein Structure."

Kolins, Leonard William (A.B., University of Arizona). *English*. Dissertation: "Optimism in the *Faerie Queene*."

Langford, Roberta Brodie (A.B., Bishop's University; A.M., Duke University). *English*. Dissertation: "The Comic Sense of Flannery O'Connor."

Lawless, Philip Austin (A.B., Rice University). *Physics*. Dissertation: "Second Sound in Dilute Solutions of ^{3}He and ^{4}He Near Absolute Zero."

Ledbetter, Freeman Hillyard, Jr. (A.B., Lincoln University). *Biochemistry*. Dissertation: "Studies of Chick Adrenal Medulla in Culture."

Lee, Fred Chai Yan (B.S.E.E., Cheng Kung University; M.S., Duke University). *Electrical Engineering*. Dissertation: "Analysis of Transient Characteristics and Starting of a Family of Power Conditioning Circuits: Two-Transistor Saturable-Core Parallel Inverters."

Levy, Thomas Allen (A.B., A.M., McGill University). *Political Science*. Dissertation: "Some Aspects of the Role of the Canadian Provinces in External Affairs: A Study in Canadian Federalism."

Linder, Lyle Dean (A.B., Case Western Reserve University; A.M., University of Texas). *English*. Dissertation: "Children in the Literary Work of Stephen Crane."

Lindley, John Mason (A.B., Amherst College; A.M., University of Pennsylvania). *History*. Dissertation: "A Soldier is Also a Citizen': The Controversy Over Military Justice in the U. S. Army, 1919-1920."

Lindley, Susan Hill (A.B., Mount Holyoke College). *Religion*. Dissertation: "Woman's Profession in the Life and Thought of Catharine Beecher: A Study of Religion and Reform."

Lue, Juh Tzeng (B.S., Chen Kung University; M.S., Tsing Hua University). *Physics.* Dissertation: "The Temperature Dependence of Conduction Electron Spin Resonance in Pure and Impure Alkali Metals."

Macdonald, Mary Elin Nadler (A.B., Catholic University). *Microbiology and Immunology.* Dissertation: "The Isolation and Characterization of Morphologically Different Forms of Myelin."

Majeski, Robert Anthony (B.S., United States Naval Academy). *Chemistry.* Dissertation: "Transport Through Asymmetric Membranes Caused by Catalyzed Reactions."

Martin, Richard Merle (A.B., Birmingham-Southern College; M.Div., Duke University). *Religion.* Dissertation: "The Weber Thesis: Its Theory, Method, and Application."

Maurice, Anthony Stewart (A.B., John Hopkins University; A.M., Middlebury College). *Romance Languages.* Dissertation: "Proust's Charlus: A Method of Characterization."

McClare, Alan David (A.B., Amherst College; A.M., Duke University). *History.* Dissertation: "Vincent Auriol in the Interwar Years."

McDaniel, Ruth Currie (A.B., Agnes Scott College; B.D., Union Theological Seminary; M.S.L.S., University of North Carolina; A.M., Duke University). *History.* Dissertation: "Georgia Carpetbagger: John Emory Bryant and the Ambiguity of Reform During Reconstruction."

McGillis, Daniel Bruce (B.S., University of Washington). *Psychology.* Dissertation: "A Correspondent Inference Theory Analysis of Attitude Attribution."

Minnetyan, Levon (B.S., Robert College; M.S., Duke University). *Civil Engineering.* Dissertation: "Large Elastic Deflection Analysis of Arbitrarily Loaded Thin Shells of Revolution by the Incremental Loading Technique."

Mohanakumar, Thalachallour (B.V.Sc., Madras Veterinary College; M.Sc., All India Institute of Medical Science). *Microbiology and Immunology.* Dissertation: "Human Leukemia Associated Antigens."

Morgan, William Floyd, II (B.S., University of Illinois; M.F., Duke University). *Forestry.* Dissertation: "The Theory of the Firm and the Behavior of Woodland Owners: A Reappraisal Based on Empirical Evidence of Owners' Behavior."

Mosley, Hugh Gallagher, Jr. (A.B., Georgetown University; A.M., Duke University). *Political Science.* Dissertation: "Hegel's Historical Conception of Politics."

Moss, Jonathan (A.B., Harvard College). *Physiology and Pharmacology.* Dissertation: "Discharge of Biogenic Amines by Scorpion Venom."

Mulligan, Winifred Joy (A.B., City College of New York; A.M., Duke University). *History.* Dissertation: "John Whethanstede: A Neglected Historian of Fifteenth Century England."

Murphy, Lynda Shapiro (A.B., M.S., University of Arkansas). *Zoology.* Dissertation: "Genetic Variability in the Deep Sea: A Study of the Rationale of Polymorphism."

Nagakubo, Senzo (A.B., San Iku Gakuin College; B.D., M.Th., Andrews University). *Religion.* Dissertation: "Investigation into Jewish Concepts of Afterlife in the Beth She^{c} Arim Greek Inscriptions."

Nassar, Rashid Nassib (B.S.E., American University of Beirut). *Physiology and Pharmacology.* Dissertation: "Light Diffraction Studies of Cardiac Muscle."

Newkirk, Gary Francis (B.S., Rutgers University). *Zoology.* Dissertation: "The Genetics of Variation in Two Species of *Littorina*: Single Locus and Polygenic Traits."

Nichols, Elizabeth Agnew (A.B., Vassar College; A.M., Duke University). *Mathematics.* Dissertation: "Locally Bounded Topologies on Finite Extension Fields of the Rationals."

Nordquest, David Arthur (A.B., Oberlin College; A.M., Duke University). *Political Science.* Dissertation: "Mill's Conception of Individuality."

Olson, Paul Ernest (B.S., Southwest Missouri State College). *Chemistry.* Dissertation: "Reactions of 12, 13-Benzo-16-Chloro[10] (2.4)Pyridinophanes."

Patterson, David Thomas (B.S., North Carolina State University; A.M., Duke University). *Botany.* Dissertation: "The Ecology of Oriental Bittersweet, *Celastrus Orbiculatus*, A Weedy Introduced Ornamental Vine."

Paulus, Nancy Jane (B.S.Ed., Ohio Northern University; M.Ed., Duke University). *Education.* Dissertation: "Analysis of Socioeconomic Group and Racial Group Score Differences on a Comparison of Two Measures of Reading Comprehension Achievement Earned by Fifth Grade Students."

Pervan, Ralph Frederick (A.B., A.M., University of Western Australia). *Political Science.* Dissertation: "The Political Socialization of the Yugoslav University Student: A Preliminary Study of Some Causes of Disaffection."

Petridis, Anastasios (B.Ec., University of Western Australia; A.M., Duke University). *Economics.* Dissertation: "The Economic Analysis of Trade Unions by British Economists, 1870-1930."

Powell, Robert Charles (A.B., Shimer College). *History.* Dissertation: "Healing and Wholeness: Helen Flanders Dunbar (1902-59) and an Extra-Medical Origin of the American Psychosomatic Movement, 1906-36."

Ramon, Fidel (B.S., Colegio Cristabal Colon; M.D., Universidad Nacional Autonoma De Mexico). *Physiology and Pharmacology.* Dissertation: "An Evaluation of the Parameters Required for a Mathematical Description of the Smooth Muscle Syncytium."

Roland, Alex (B.S., United States Naval Academy; A.M., University of Hawaii). *History.* Dissertation: "A Triumph of Natural Magic: The Development of Underwater Warfare in the Age of Sail, 1571-1865."

Romans, Alice Yvonne (B.S., Marshall University). *Chemistry.* Dissertation: "Bovine Carbonic Anhydrase. I. Kinetics of Zinc(11) Dissociation. II. Temperature Dependence of the Circular Dichroism of Two Metallo-Carbonic Anhydrases. III. The Effects of pH and Guanidine Hydrochloride on Circular Dichroism of Cobalt Carbonic Anhydrase."

Rothstein, Thomas Lane (B.S., George Washington University). *Physiology and Pharmacology.* Dissertation: "Lysosomal Physiology in *Tetrahymena.*"

Sattin, Dana Bruce (A.B., Boston University; A.M., Duke University). *Psychology.* Dissertation: "The Effects of Expectancy and Professional Identity upon Attributions of Mental Illness."

Schabel, Hans Georg (B.S., M.S., University of Freiburg). *Forestry.* Dissertation: "The Mode of Infection of *Hylobius Pales* (Herbst) with *Metarrhizium Anisopliae* (Metsch.) Sorok."

Sewell, William Jacob (A.B., LaGrange College; A.M., University of Alabama). *English.* Dissertation: "Literary Structure and Value Judgement in Novels of Saul Bellow."

Sides, Paul Jesse, Jr. (A.B., Centre College). *Pathology.* Dissertation: "Active Sodium Transport Suppression in Toad Bladder Caused by the Insecticide DDT, An Inhibitor of Na^+, K^+-ATPase."

Sijacki, Djordje (B.S., M.Sc., University of Belgrade). *Physics.* Dissertation: "The Unitary Irreducible Representations of SL(3,R) in the Algebraic Approach to Hadronic Physics."

Sinks, John D. (A.B., Kenyon College; A.M., Duke University). *Philosophy.* Dissertation: "Definite Descriptions in a Modal Language."

Skillen, James William (A.B., Wheaton College; B.D., Westminster Theological Seminary; A.M., Duke University). *Political Science.* Dissertation: "The Development of Calvinistic Political Theory in the Netherlands, with Special Reference to the Thought of Herman Dooyeweerd."

Smith, William Donald (A.B., M.M.E., Rice University). *Biomedical Engineering.* Dissertation: "Some Effects of Shear on Blood Functions."

Snider, Jerry Allen (A.B., Southern Illinois University; A.M., University of North Carolina). *Botany.* Dissertation: "A Revision of the Genus *Archidium* (Musci)."

Snow, Malinda Gar (A.B., Agnes Scott College; A.M., Duke University). *English.* Dissertation: "Defoe's Puritan Context."

Snyder, Melvin Leroy (A.B., Yale University; A.M., Duke University). *Psychology.* Dissertation: "The Field Engulfing Behavior: An Investigation of Attributing Emotional States and Dispositions."

Souter, Rex Walter (A.B., State University of New York). *Chemistry.* Dissertation: "Studies of Chromatographically Significant Asymmetric Solute-Solvent Interactions."

Spencer, Sonia Beron (A.B., Hunter College; A.M., Pennsylvania State College). *Romance Languages.* Dissertation: "*The Aliscans*: A Focal Point of Late Epic Themes."

Steele, Betty Jean (A.B., Guilford College, A.M., Duke University). *English.* Dissertation: "Quaker Characters in Selected American Novels, 1823-1899."

Stillman, David George (A.B., American University; A.M., Duke University). *Political Science.* Dissertation: "Population-Related Policy: A Framework for Analysis with Examination of Two Cases (Togo and Ghana)."

Sullivan, Karen Ann (B.S., North Adams State College). *Microbiology and Immunology.* Dissertation: "An Investigation into the in Vitro Reactivity, Morphology and Antigenic Characteristics of Peritoneal Exudate Lymphoid Cells from Balb/c Mice Immune to EL4 Ascites Leukemia."

Sykes, Thomas Michael (A.B., A.M., University of Washington). *Political Science.* Dissertation: "Society, Power and Representation in Indian Politics: A Case Study of Haryana State."

Thomas, Lindsey Kay, Jr. (B.S., Utah State University; M.S., Brigham Young University). *Botany.* Dissertation: "The Impact of Three Exotic Plant Species on the Native Vegetation of a Potomac Island."

Tiedeman, James Stuart (A.B., Drake University). *Physics.* Dissertation: "A Determination of $g_J(H,^2S_{\frac{1}{2}})/g_S(e^-)$."

Timmerman, Frederick Whiting, Jr. (B.S., United States Military Academy; M.Ed., Duke University). *Education.* Dissertation: "Prediction of Enlisted Soldier Discipline Problems in Line Combat Units of the United States Army."

Tomek, James Joseph (A.B., St. Peter's College; A.M., Duke University). *Romance Languages.* Dissertation: "Relationship of Literature and Film in Cocteau."

Trivedi, Harit Purushottamadas (B.Sc., Indian Institute of Technology; A.M., Duke University). *Physics.* Dissertation: "Brueckner-Hartree-Fock Calculations in Two Nuclear Models for Closed Shell and Superheavy (A=298, Z=114) Nuclei Using Effective K-Matrix."

Tschang, Pui-Suen Wong (B.S., Hong Kong Chu-Hai College; M.S., North Texas State University). *Chemistry.* Dissertation: "Structural Studies by Diffraction Methods."

Tsui, Yuet (B.Sc., University of Hong Kong). *Civil Engineering.* Dissertation: "A Fundamental Study of Tied-Back Wall Behavior."

Wallis, Thomas Gary (A.B., Murray State University). *Chemistry*. Dissertation: "Synthetic and Theoretical Approaches to Polar Cycloaddition."

Webbink, Patricia Glixon (A.B., Connecticut College; A.M., Duke University). *Psychology*. Dissertation: "Eye Contact and Intimacy."

Weidlich, Wayne Henry (A.B., M.S., University of New Hampshire). *Botany*. Dissertation: "The Organization of the Vascular System in the Stems of the Nymphaeaceae."

Weidner, Peter Risk (B.S., Albright College). *Mathematics*. Dissertation: "Fraisse Recursiveness of the Set of Expressions on a Finite Alphabet."

Weisiger, Richard Atlee (A.B., Princeton University). *Biochemistry*. Dissertation: "The Superoxide Dismutases from Chicken Liver: Organelle Specificity: New Evidence for the Symbiotic Origin of Mitochondria."

Westerman, Ira John (B.S., University of Kentucky; A.M., Duke University). *Chemistry*. Dissertation: "The Cycloadditions of Quaternary Salts: A Mechanistic Study."

Wilbur, Frederick (A.B., University of Maine; A.M., Duke University). *English*. Dissertation: "Henry Fielding's Life in the Theatre and the New Species of Writing."

Wilbur, Grace Mary Garry (A.B., Sweet Briar College; A.M., Duke University). *English*. Dissertation: "The Syllables of Recorded Times: A Study of Shakespeare's Treatment of Time in the Two Tetralogies."

Wilson, Peter Alan (A.B., Lafayette College). *Philosophy*. Dissertation: "Psychologism in Hume."

Winkle, John Wilson, III (A.B., Mercer University; A.M., Duke University). *Political Science*. Dissertation: "Judicial Statesmanship: Protagonists for Habeas Corpus Reform, 1948-1973."

Wiseman, David Reid (A.B., A.M., Duke University). *Botany*. Dissertation: "Morphological and Taxonomic Studies of Red Algal Genera *Ochtodes* and *Chrondrococcus*."

Yesley, Joel M. (A.B., Clark University; A.M., University of Pennsylvania). *Economics*. Dissertation: "Bank Mergers and the Public Interest: The Evidence from Ohio, 1962-1969."

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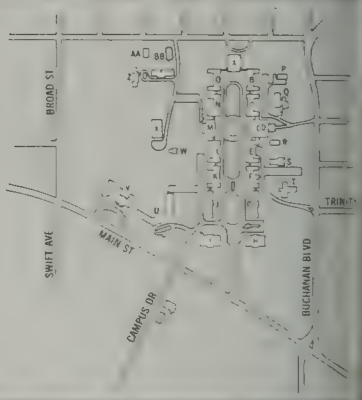
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MAP OF DUKE UNIVERSITY

East Campus

A Baldwin Auditorium
B Bassett House
C Brown House
D Union Building
E Faculty Apartments
F Art Museum, Geology
G Aycock House
H East Duke Building
I West Duke Building
J Jarvis House
K Carr Building
L Giles House
M Woman's College Library
N Alspaugh House
O Pegram House
P Duke Press
Q Infirmary
R Ark
S Crowell Building
T Epworth Inn
U Gilbert Addoms House
V Southgate Hall
W Campus Center
X Woman's College Gymnasium
Y Asbury Building
Z Bivins Building
AA Art Building
BB Branson Building



West Campus

A Duke Chapel
B Divinity School
C Gray Building
D Perkins Library
E Language Center
F Old Chemistry Building
G Davison Building, School of Medicine
H Hospital Main Entrance
I Gerontology, D & T, Clinical Research
J Duke Hospital
K Sociology, Psychology
L Social Sciences
M Allen Building
N Few Quadrangle
O Craven Quadrangle
P Wannamaker Hall
Q Crowell Quadrangle
R Clock Tower Court
S Kilgo Quadrangle
T Union Building
U Flowers Building, Page Auditorium
V Card Gymnasium
W Indoor Stadium
X School of Law
Y Gross Chemical Laboratory
Z Biological Sciences
AA Plant Environment Laboratory
BB Physics Building
CC Nuclear Laboratory
DD School of Engineering
EE Army Research
FF Medical Center Research Buildings
GG Nanaline H. Duke Medical Sciences Building
HH Warehouse, Shop
II Bell Building
JJ Hanes House, School of Nursing
KK Hanes House Annex
LL Pickens Rehabilitation Center
MM Graduate Center
NN Alumni House
OO Commonwealth Studies Center
PP Personnel Office
QQ International House
RR Personnel Office
SS Education Improvement Program, A Better Chance Program
TT International Studies Center
UU Campus Stores Office
VV Office of Institutional Advancement
WW Information Services, Visitors Bureau
XX Admissions Office
YY Edens Quadrangle
ZZ Wade Stadium




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Trinity College of Arts and Sciences
The School of Engineering
The School of Nursing

1975-1976

Durham, North Carolina 1975

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University Calendar—1975-1976

1975

August

28 Thursday—Orientation begins: assemblies for all new undergraduate students

September

2 Tuesday, 9:00 a.m.—Fall semester classes begin

October

17 Friday—Last day for reporting midsemester grades
27-30 Monday-Thursday—Registration for spring, 1976

November

25 Tuesday, 6:00 p.m.—Thanksgiving recess begins

December

1 Monday, 9:00 a.m.—Classes are resumed
7 Sunday—Founders' Day
9 Tuesday, 6:00 p.m.—Fall semester classes end
10-11 Wednesday-Thursday—Reading Period
12 Friday—Final examinations begin
19 Friday—Final examinations end

1976

January

8 Thursday—Orientation begins: assemblies for all new students
9 Friday—Registration and matriculation of new and non-registered students
12 Monday, 9:00 a.m.—Spring semester classes begin

February

20 Friday—Last day for reporting midsemester grades

March

5 Friday, 6:00 p.m.—Spring recess begins
15 Monday, 9:00 a.m.—Classes are resumed
3/29-4/1 Monday-Thursday—Registration for fall and summer, 1976

April

23 Friday, 6:00 p.m.—Spring semester classes end
24-26 Saturday-Monday—Reading Period
27 Tuesday—Final examinations begin

May

4 Tuesday—Final examinations end
8 Saturday—Commencement begins
9 Sunday—Commencement: Baccalaureate Service and Graduation Exercises

University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
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Anne Flowers, Ed.D., *Assistant Provost for Educational Program Development*
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
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Benjamin Edward Powell, Ph.D., *Librarian*
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Clark R. Cahow, Ph.D., *University Registrar and Acting Director of Admissions*
Olan Lee Petty, Ph.D., *Director of the Summer Session*
Rufus H. Powell, LL.B., *Secretary of the University*
Charles Linn Haslam, J.D., *University Counsel*

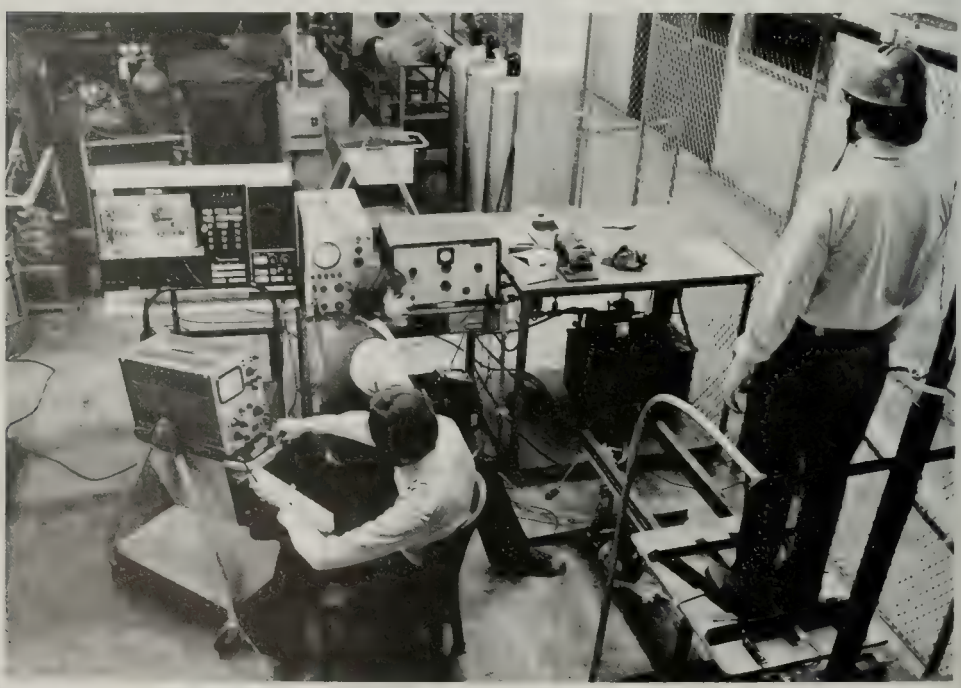
Undergraduate Administration

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Aleksandar Vesić, D.Sc., *Dean of the School of Engineering*
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Shirley Hanks, A.B., *Associate Director of Career Development and Continuing Education*
Ada Most, R.N., Ed.D., *Director of Academic Programs of the School of Nursing*

Elaine T. Nagey, B.A., M.Ed., *Staff Assistant for Academic Affairs of the School of Nursing*
Elizabeth Studley Nathans, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
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Richard J. Rohlf, Ph.D., *Director of the University Counseling Center*
Judith M. Schwartz, B.A., *Assistant to the Dean of the School of Nursing*
Ella E. Shore, M.R.E., M.A., *Dean of Student Affairs of the School of Nursing*
Gerald L. Wilson, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Ellen W. Wittig, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*







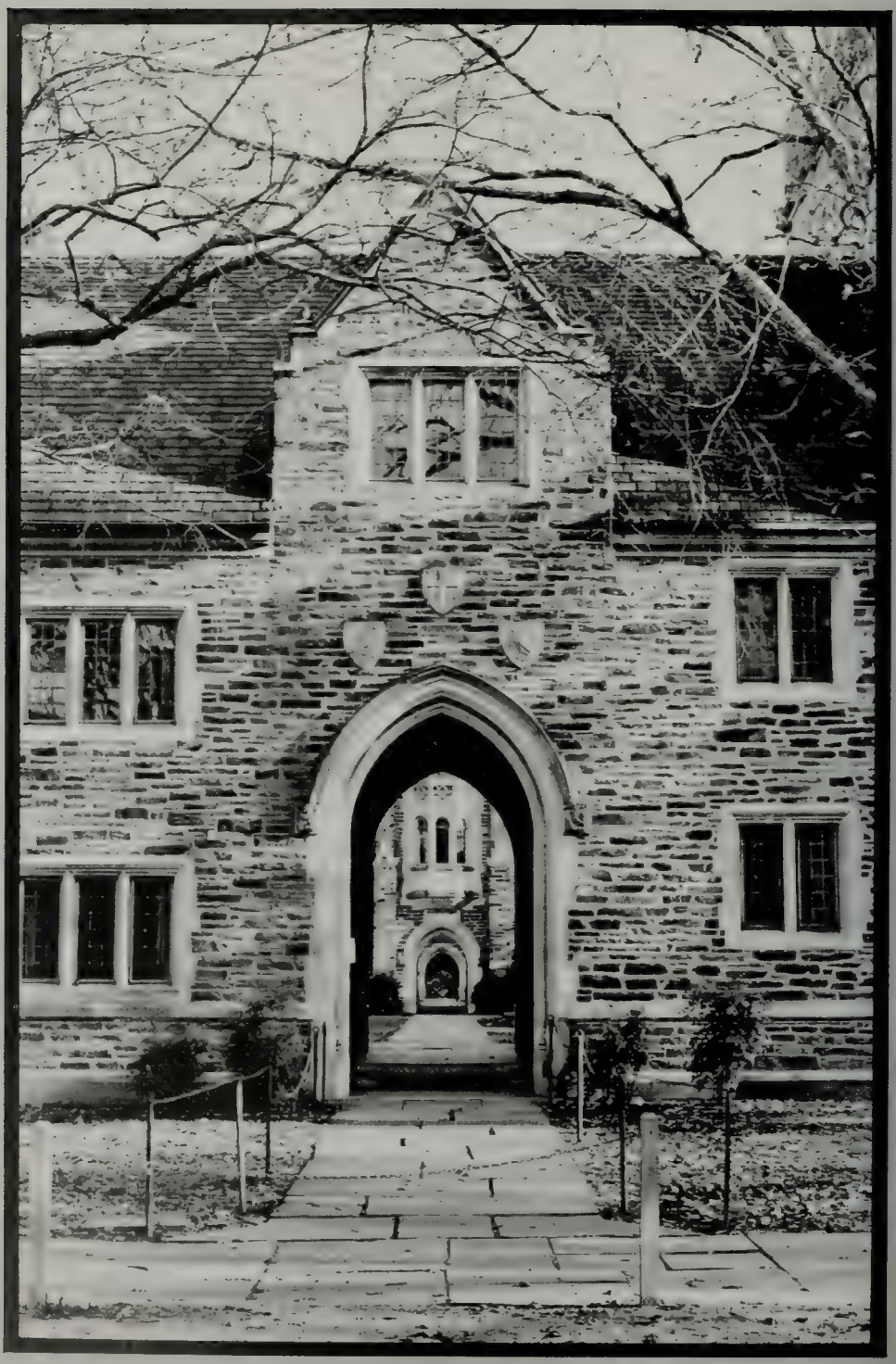
Boards of Visitors

The School of Engineering

Edwin A. Bescherer, *Retired Executive Director of Laboratories, Bell Telephone Company*
Theodore G. Birdsall, *Professor, Department of Electrical and Computer Engineering, University of Michigan*
Carl C. Chambers, *University Professor of Engineering, University of Pennsylvania*
Paul F. Chenea, *Vice President, General Motors Corporation*
Carl F. Floe, *Vice President for Research Administration, Massachusetts Institute of Technology*
Harold L. Flowers, *Program Manager, Weapon Systems Integration, McDonnell Douglas Astronautics Company*
George R. Herbert, *President, Research Triangle Institute*
Walter C. Johnson, *Professor, Department of Electrical Engineering, Princeton University*
Kenneth H. Keller, *Professor, Department of Chemical Engineering and Materials Science, University of Minnesota*
William S. Lee, *Vice President for Engineering and Construction, Duke Power Company*
Nathan M. Newmark, *Professor, Department of Civil Engineering, University of Illinois*
Morrough P. O'Brien, *Professor/Consultant, Coastal and Oceanographic Engineering Laboratory, University of Florida*
Simon Ostrach, *Head, Division of Fluid, Thermal and Aerospace Sciences, Case Western Reserve University*
Robert H. Pinnix, *President, R. H. Pinnix, Inc.*
William M. Siebert, *Professor, Electrical Engineering Department, Massachusetts Institute of Technology*
Wilbur S. Smith, *Wilbur Smith and Associates, Consulting Engineers*
W. Brewster Snow, *Quirk, Lawler, and Matusky Engineers*
F. W. Steckmest, *Consultant, Public Affairs, Shell Oil Company*

The School of Nursing (Medical Center)

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Edward H. Benenson, *President, Benenson Management Company, Inc.*
Earl W. Brian, *Secretary, Health and Welfare Agency of California*
John A. D. Cooper, *President, Association of American Medical Colleges*
Kenneth R. Crispell, *Dean, School of Medicine, University of Virginia*
Harry Eagle, *Associate Dean, Albert Einstein College of Medicine*
James R. Felts, Jr., *Executive Director, Hospital and Child Care Sections, Duke Endowment*
Loretta Ford, *Dean, School of Nursing, University of Rochester*
C. Henry Kempe, *Chairman and Professor of Pediatrics, University of Colorado*
John H. Knowles, *President, Rockefeller Foundation*
Alexander Leaf, *Chairman of the Department of Medicine, Harvard Medical School*
Raymond D. Nasher, *The Raymond D. Nasher Company*
William R. Pitts, *Physician, Charlotte, North Carolina*
Anne R. Somers, *Associate Professor of Community Medicine, Rutgers Medical School*
Mitchell W. Spellman, *Dean, Charles R. Drew Postgraduate Medical School*
Richard J. Stull, *Executive Vice President, American College of Hospital Administrators*



General Information



Duke University

In 1839 a group of citizens from Randolph and adjacent counties in North Carolina assembled in a log schoolhouse to organize support for a local academy founded a few months earlier by Brantley York. Prompted, they said, by "no small share of philanthropy and patriotism," they espoused their belief "that ignorance and error are the banes not only of religious but also civil society which rear up an almost impregnable wall between man and happiness." The Union Institute which they then founded was reorganized in 1851 as Normal College to train teachers, and again in 1859 as Trinity College, a liberal arts college which in 1892 moved from the fields of Randolph County to the growing city of Durham, North Carolina. It was this college which James B. Duke selected as the major recipient of a fortune when, in 1924, he provided endowment funds for the university that would bear his name.

The old Trinity College had, like almost all institutions in America at the time in which it was founded, been restricted to men. In 1896, Washington Duke gave an endowment with the condition that women be admitted "on equal footing with men." Thereafter, women were educated in Trinity College, and in 1930 The Woman's College was established as a separate, coordinate college. For over forty years, these coordinate colleges continued, with instruction being offered by the University faculty, but with residents remaining a mile apart, the women on East Campus, the site of old Trinity College, and the men on West Campus, the site of the newer Duke University buildings begun in 1924. In order to assure that women were indeed admitted "on equal footing with men," and to recognize that the education which men and women had received at Duke had long taken place in the same classrooms, the University merged these coordinate colleges in 1972 to form Trinity College of Arts and Sciences, an administrative unit responsible for undergraduate admissions, programs of instruction, academic and personal counseling, and residential life.

Instruction in engineering started at Normal College in 1851 and was continued at Trinity College as an option in the arts and sciences program. With the establishment of Duke University in 1927, the Departments of Civil and Electrical Engineering were formed, and a Department of Mechanical Engineering was added in 1931. The three engineering departments joined to form the Division of Engineering in 1937 as a separate administrative unit of the University. In 1939, this Division was renamed the College of Engineering and in 1966 it became a professional school of engineering. A Division of Biomedical Engineering was added in 1967, and it achieved departmental status

in 1971. In 1974 the name of the Mechanical Engineering Department was changed to Mechanical Engineering and Materials Science. All four departments offer courses leading to B.S.E., M.S., and Ph.D. degrees.

The School of Nursing was established in 1931 in association with the School of Medicine and Duke Hospital. The three-year curriculum led to the Diploma in Nursing. After 1938 any student who also completed two years of acceptable college work was awarded a Bachelor of Science degree as well. A four-year program leading to the degree of Bachelor of Science in Nursing was approved by the University Board of Trustees in 1953, when the School of Nursing was incorporated into the Division of Health Affairs.

As the University developed around the core of undergraduate colleges and schools, its Graduate School expanded in areas of instruction and research. The School of Law of Trinity College became the Duke University School of Law, and other professional schools were established. The Divinity School was organized in 1926, the School of Medicine in 1930, the School of Forestry in 1938, and the Graduate School of Business Administration in 1969.

Duke, a privately supported, church-related (Methodist) University, has about 8,500 students enrolled in degree programs. These students annually represent nearly every state and sixty foreign countries; there are now more than 47,000 alumni in all fifty states and in many foreign countries. The University is a member of the North Carolina and Southern Associations of Colleges and Schools, and of the Association of American Universities.

From academy to university some of the basic principles have remained constant. The Duke University motto, *Eruditio et Religio,* reflects a fundamental faith in the union of knowledge and religion, the advancement of learning, the defense of scholarship, the love of freedom and truth, a spirit of tolerance, and a rendering of the greatest service to the individual, the state, the nation, and the church. Through changing generations of students the objective has been to encourage each individual to achieve to the extent of his capacities an understanding and appreciation of the world in which he lives, his relationship to it, his opportunities, and his responsibilities.



Resources of the University

The Faculty. The University faculty of almost 1,150 maintains a tradition of personal attention to students. Many members of the faculty are or have been national leaders in their various professional organizations, as well as consultants to industry, government, or foundations, and their contributions to scholarship include many publications growing out of research. To honor outstanding faculty members, the University has established more than thirty James B. Duke professorships, in addition to other named professorships.

The Libraries. To support a rich educational experience in a world of rapid and far-reaching change, great library collections are essential. Undergraduate students at Duke are fortunate to have available exceptional resources. The University library, among the nation's twenty largest university libraries, contains 2,534,198 volumes, 4,435,860 manuscripts, and about 250,000 maps, broadsides, photographs, and materials in microtext form. Almost 14,500 periodicals and 200 newspapers are received currently.

A division of photographic services, with the most modern cameras and other equipment for microfilming and photographing printed and manuscript materials, provides reading machines to serve the library's large collection of microtext copies of rare books, periodicals, and newspapers. In addition to ample study space there are comfortable reading rooms for those consulting rare books, manuscripts, government publications, newspapers, and periodicals.

The East Campus Library contains 216,893 volumes in an open stack collection, chiefly those books most frequently used in the undergraduate curriculum. The School of Engineering also maintains its own library which contains 52,440 volumes and 500 periodicals. As part of the Medical Center Library, the School of Nursing Library, located in Hanes House, has reference materials including over 7,000 books, current periodicals, and audiovisual aids. The School of Medicine Library contains 126,592 volumes and 1,600 current periodicals and is open to nursing students. Undergraduates also have access to additional departmental and professional school libraries plus those of nearby universities through an interlibrary loan service.

Computation Center. The Duke University Computation Center provides the University faculty and students with a facility for research and instruction. The center is presently equipped with an IBM System 370 Model 135 (240K bytes, one 3330-type disk facility, three tape drives, two card readers, two printers, and a digital plotter) which is connected by high-speed telephone lines to an IBM System 370 Model 165 (three million bytes of memory, one 2314 and two 3330-type disk facilities, seven tapes, card reader, and printer) located at the Triangle Universities Computation Center (TUCC) in the Research Triangle Park. Also located at TUCC is a Hewlett-Packard 2000F computer which provides BASIC interactive computing. Connected to TUCC are three medium-speed terminals (card reader and printer) located in the Engineering Building, the Biological Sciences Building, and the Sociology-Psychology Building, as well as several other low-speed keyboard terminals.

TUCC is a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill. All users of the Computation Center facilities are urged to obtain funds to pay for computer services. Any user unable to obtain grant funding may ask for financial support from his department when he applies for the services.

More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

Science Laboratories. In addition to the teaching and research laboratories in the departments of natural and social sciences, and in the Schools of Engineering and Nursing, there are other facilities in which some advanced undergraduates work on individual projects. These include the Duke University Marine Laboratory in Beaufort, North Carolina; the Highlands Biological Laboratory in Highlands, North Carolina; the phytotron of the Southeastern Plant Environment Laboratories located on the Duke campus; the Duke Forest adjacent to the campus; and the Triangle Universities Nuclear Laboratory also on the campus.

School of Nursing Instructional Facilities. Facilities for instruction in the School of Nursing include resources in the undergraduate college as well as in professional and graduate schools of Duke University and in the clinical facilities at Duke Hospital, Durham Veterans Administration Hospital, North Carolina Cerebral Palsy Hospital, Durham City-County Health Department, John Umstead Hospital, Johnston County Health Department, and other health agencies in the vicinity.

The Undergraduate College and Schools

In Trinity College of Arts and Sciences and the Schools of Engineering and Nursing, instruction is offered by University faculty who engage in research and in graduate and undergraduate teaching. Duke offers its undergraduates the opportunity to study with many internationally recognized authorities in their disciplines, and with faculty members who are jointly committed to undergraduate instruction and to the advancement of knowledge. The University recognizes that students learn not only through formal lectures, but also through the interplay of ideas among faculty members and students; thus, it offers undergraduates opportunities to test their ideas against those of their professors and to observe at close range those who have committed their lives to academic careers.

Trinity College of Arts and Sciences. The undergraduate liberal arts student at Duke University has many options of curricular and cocurricular programs and of residential life. The curricular offerings, the educational facilities, and the University faculty of arts and sciences within Duke University provide students with a maximum opportunity for the development of special interests and talents. The cocurricular programs and activities in the residence halls reinforce the academic curriculum and provide various ways of bringing students and faculty together. Living-learning interest groups occupy some residences in part or in total. Such groups as fraternities, men's dormitories, and women's dormitories have joined in federations to sponsor academic and cocurricular programs.

School of Engineering. The undergraduate engineering program at Duke University is designed both for students who intend to become professional engineers and for those desiring a modern, general education, based on the problems and the promises of a technological society. The environment in which students are educated is as important in shaping their future as their classroom experiences. In the Duke School of Engineering, this environment has two major components: one of modern technology derived from the re-

search and design activities of faculty and students in the School; and the other, the liberal arts environment of the total University, with its humanitarian, social, and scientific emphases.

Engineering is not a homogeneous discipline; it requires many special talents. Some faculty members in the School of Engineering are designers; they are problem-oriented, concerned with teaching students how to solve problems —how to synthesize relevant information and ideas and apply them in a creative, feasible design. Other engineering faculty members function more typically as scientists; they are method-oriented, using the techniques of their discipline in their teaching and research to investigate various natural and man-made phenomena.

Engineering students at Duke develop the facility to reason and to communicate in at least two "languages"—English and mathematics—and they learn to understand man in both a private and a social context so they can apply technology to help improve the quality of life.

School of Nursing. The School of Nursing is committed to promoting human health and welfare by providing foundations for knowledgeable nursing services. In support of this the School of Nursing aims to prepare its graduates to function as practitioners of professional nursing in roles most appropriate to the level of their preparation and to provide its students with an educational background which will serve as a basis for advanced study in nursing in addition to continued professional and personal growth.

The faculty of the School of Nursing subscribes to the concept that a professional nurse is a person who has acquired the specialized knowledge of nursing, who has attained abilities useful in the practice of nursing, and who has developed attitudes appropriate to the profession of nursing.

The faculty conceives professional nursing to be a service which contributes to the health and well-being of people. Professional nursing practice is interacting with human beings under stress, frequently over long periods of time; providing comfort and support in times of pain, anxiety, loneliness, and helplessness; using the nursing process to make judgments in establishing, implementing, maintaining, and/or modifying a plan of health care; and knowing when and how to use existing and potential resources to help patients toward recovery and adjustment. Professional nursing practice is sharing responsibility for the health and welfare of all those in the community; participating in programs designed to prevent illness and maintain health; coordinating professional and technical services in the best interest of patient care; and supervising, teaching, and directing those who give nursing care. Professional nursing practice requires constant evaluation; asks questions and seeks answers which will add to the body of nursing knowledge; and transmits and uses this knowledge, including research findings, to improve health services. Professional nursing practice requires knowledge and skill of a high order and provides opportunities for personal and professional fulfillment.

The faculty of the School of Nursing believes that the primary aim of nursing education is to provide an environment in which the student can develop self-discipline, intellectual curiosity, the ability to think critically, and acquire knowledge and skills necessary for practice. It believes that learning is manifested by change of behavior, resulting from experience; that an atmosphere for learning is offered in a climate which encourages self-direction and creativity; that the student who seeks admission to the School comes with the intent of practicing professional nursing; and that the curriculum offered aids the student in realizing this intent and in stimulating the desire for continued professional growth.



Degree Programs



Degrees Offered

Duke University offers in Trinity College of Arts and Sciences the degrees of Bachelor of Arts and Bachelor of Science; in the School of Engineering, the degree of Bachelor of Science in Engineering; and in the School of Nursing, the degree of Bachelor of Science in Nursing. Within the four-year curriculum of each college or school, the student has the major responsibility for designing and carrying through a course program appropriate to his background and goals. He is assisted in this task by a faculty adviser, departmental directors of undergraduate studies, supervisors of freshman instruction, and by the academic deans of his school or college.

Credit toward the degrees is earned in units called semester-courses (s.c.), which ordinarily consist of three to four hours of instruction each week of the semester. Double-courses, half-courses, and quarter-courses are also recognized.

Trinity College of Arts and Sciences

In the arts and sciences curriculum either of two programs leads to the Bachelor of Arts or Bachelor of Science degree. The programs provide a variety of approaches to a liberal arts education and in both Program I and Program II a student may study in the following divisions of learning.

Humanities. Art, Classical Studies (including Greek and Latin), Comparative Literature, Drama, English, Germanic Languages and Literature, Judaic Studies, Music, Philosophy, Religion, Romance Languages (including French, Italian, Portuguese, and Spanish), and Slavic Languages and Literatures (including Russian).*

Natural Sciences and Mathematics. Botany, Chemistry, Computer Science, Genetics, Geology, Marine Sciences, Mathematics, Physics, and Zoology.

Social Sciences. Anthropology, Canadian Studies, Economics, Education, Health Education, History, Management Sciences (including Accounting), Physical Education, Political Science, Psychology, Public Policy Studies, and Sociology.*

*Also included are Black Studies, Comparative Area Studies, Linguistics, and Medieval and Renaissance Studies.

PROGRAM I

Program I provides a flexible approach to the Bachelor of Arts or Bachelor of Science degree by enabling a student to choose, within broadly stated requirements, the particular subjects which best suit his intellectual interests and educational goals. The requirements, in brief, are listed below with page references to specific discussions of each.

1. The satisfactory completion of 32 semester-courses, including:
   (*a*) at least 16 at Duke (ordinarily including the work of the senior year);
   (*b*) at least 12 at the advanced level;
   (*c*) no more than 4 in military science; and
   (*d*) no more than 2 with a grade of *D*.
   (See pages 10, 11, and 40.)
2. A distribution of courses among the three divisions of learning. (See below.)
   Division I: the courses of the major. (See pages 8, 9, 10, and the section on Departmental Major following each department's course descriptions.)
   Division II: at least 4 semester-courses, including 2 at the advanced level, in one of the remaining, non-major divisions. (See pages 9 and 10.)
   Division III: at least 2 semester-courses. (See page 9.)
3. Proficiency in English composition. (See page 9.)
4. Small-group learning experiences:
   (*a*) before reaching junior status
      (1) at least one full semester-course designated as a *seminar, tutorial,* or *independent study,* or
      (2) a combination of two *preceptorials* or *discussion sections.*
   (*b*) junior and senior years: at least 2 semester-course credits for *seminars, tutorials, independent study or a thesis.*
   (See pages 9 and 10.)
5. Physical activity for two semesters. (See page 10.)
6. Quality of work: all passing grades are expected. (See pages 12-13 for minimum requirements.)

Distribution of Courses. The student in Program I completes at any time within eight semesters a number of semester-courses in each of the three divisions of learning (see below). The courses selected in each division must be those in which the essential subject matter and substance of the discipline are presented, i.e., not skill courses. An interdepartmental course, an interdivisional course, or a course from a professional school may not be used to satisfy distributional requirements unless it is cross-listed in an arts and sciences department. Courses offered in one division may not be used to satisfy distributional requirements in another division. Courses used to satisfy the requirements for small-group experiences may be used to satisfy distributional requirements. Courses taken on the pass/fail basis do not satisfy the distributional requirements unless offered only on a pass/fail basis. A student must complete a certain number of courses, excluding skill courses, in each of the three divisions as follows:

First Division. The division of the major (or concentration) is called the first division. Each student must complete requirements for a major (concentration) in a single discipline or in an interdisciplinary program. In so doing he will automatically satisfy the requirement for one division. (See page 38.)

Second Division. A student must pass at least 4 semester-courses in a second division of his own choice. At least 2 of the 4 courses must be at the advanced level. (See page 10 regarding advanced work.)

Third Division. A student must pass at least 2 semester-courses in the third division of his choice.

Skill Courses That Do Not Satisfy Distributional Requirements of Program I*

Art	53-54, 119
Chinese	131, 132
Classical Studies	Greek 1-2 Latin 1-2
Drama	101, 102, 103, 105
Education	105, 106, 107, 108, 151, 152, 161, 162, 195S, 196, 201, 215S, 216, 225, 226, 236, 237, 239, 246, 266, 276
English	1, 10, 50, 65S, 66S, 101S, 103S, 104S, 105S, 106S, 110, 120, 130, 139
German	1-2, 63, 105, 117, 118, 181, 182
Health Education	134
Physical Education (Women)	61-62, 102, 103, 105, 106, 117, 132, 161-162
Physical Education (Men)	100-101, 110-111, 121, 125, 126, 127, 130, 132, 133, 137, 140, 141, 142, 163, 164, 170, 171, 172, 173
Hindi-Urdu	181, 182, 183, 184
Japanese	151, 152, 153, 154
Mathematics	19
Music	7-8, 65, 107-108, 151, 152, Applied Music (except for tutorials)
Psychology	117
Romance Languages	French 1-2, 63, 74, 76, 100, 150T, 181 Italian 1-2, 63, 74, 100 Portuguese 181 Spanish 1-2, 63, 74, 76, 100, 150T, 181
Russian	1-2, 63-64
Swahili	101, 102

*In addition, certain courses, e.g., military science courses and courses offered in the professional schools, do not satisfy distributional requirements.

Proficiency in English Composition. Each student is required to demonstrate his ability to write effective English prose either by presenting a score of 700 or higher on the College Entrance Examination Board (CEEB) English Composition Achievement Test, or by passing a semester-course (English 1) in English composition usually in the first semester of enrollment.

Proficiency in Foreign Language. Certain departments recommend or require foreign language proficiency for their majors. Candidates for the B.S. degree may be required by their major departments to be proficient in a particular foreign language. (See pages 33 and 34.)

Small-Group Learning Experiences. In supplementing the classroom and large lecture method of instruction, small-group learning experiences assure the student opportunities to engage in discussion, develop skills, refine judgment, and have his ideas challenged. A *seminar* (ordinarily indicated by the suffix S) consists of a group of twelve to fifteen students who together with an instructor engage in disciplined study and discussion. A *preceptorial* (*P*) is a discussion meeting between an instructor and, usually, no more than twelve students. It is an additional and optional unit attached to a regular course and involves an extra meeting weekly. A *discussion section* (*D*) is comprised of approximately ten students and an instructor in a group that is part of a regular

course. It differs from a preceptorial in that every student in the course participates in a discussion group; whereas the preceptorial is optional. A *tutorial* (*T*) is a meeting between an instructor and, usually, one to five students, independent of any other course. *Independent study* varies according to the subject matter and research methods of the disciplines and the interests of students and their supervising professors. It may consist of extensive reading and research in the literature of a discipline, followed by the writing of a substantial paper, a laboratory research project, work in field research, or the composition of a play or a novel. A special form of independent study is the preparation of a thesis or the completion of a major independent project in the junior, but more often in the senior year. For some students it provides an opportunity for integrating their understanding of several disciplines. For others it permits intensive consideration of specific topics previously encountered but insufficiently explored. See page 38 for procedures for enrolling in independent study. The requirements for small-group experiences are listed on page 8.

Major (Concentration). Although a student in Program I is required to achieve breadth of intellectual experience by taking courses in each of the three divisions of learning, he is also expected to acquire some mastery of a particular discipline or interdisciplinary area. Each student will, therefore, complete a departmental major, an interdisciplinary major, or an interdepartmental concentration. (See page 38 for procedures for declaring the major or concentration.)

Departmental Major. To pursue a departmental major, a student in Program I must pass a number of courses within the major department as specified by that department as well as courses in other departments as may be necessary or helpful for effective performance in the major. These requirements are set forth in the section following each department's course descriptions. A major consists of at least 5 courses in one department above the introductory level, but not more than 8 semester-courses for the A.B. degree and not more than 10 semester-courses for the B.S. degree. If he wishes, the student may elect a more intensive major program. A student who completes requirements for the major in two departments may have both majors recorded on his official record. Foreign language departments may at their discretion begin their major after the elementary and intermediate courses.

Interdisciplinary Major. A student may satisfy the requirement by completing work prescribed for a major in an approved program. These programs include Black Studies; Comparative Area Studies: Africa, Asia, Latin America; Comparative Literature; Genetics; and Medieval and Renaissance Studies.

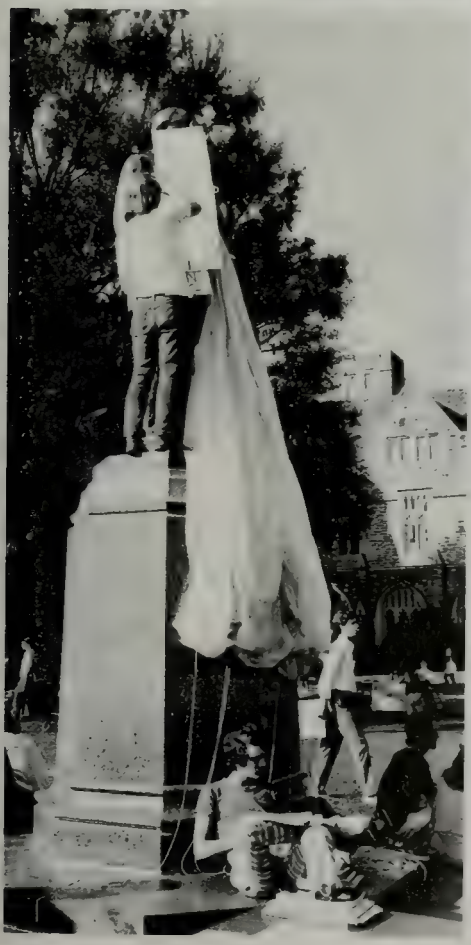
Interdepartmental Concentration. A student in Program I may desire to pursue an interdisciplinary program of his own and his advisers' design as an alternate means of satisfying the major requirement. An interdepartmental concentration consists of at least 3 courses beyond the introductory level in each of two or more departments. (See page 38 for procedures for planning an interdepartmental concentration.)

Advanced Courses. Of the 32 courses required for graduation, at least 12 must be at the advanced level. Normally, these courses are numbered in the 100- and 200-series.

Physical Activity. All students are required to complete two semesters of approved physical activity unless excused for medical reasons. This requirement may be met either by satisfactory completion of physical education courses









or by an alternate form of physical activity approved by the appropriate department of physical education. The work is normally completed in the freshman year. Pass/fail grades are assigned, and credit for the courses or alternative activities do not count among the 32 courses needed for graduation. Elective activity courses for credit are available for students who have completed the requirement. A student who has completed a full calendar year or more of active duty in the military forces of the United States may be excused from this requirement.

Military Science Courses. No more than 4 courses in the military sciences may be counted among the 32 courses required for graduation. These courses are normally taken in the junior and senior years. Additional courses, although not counted toward graduation, do appear on a student's permanent academic record.

Residence. A residence period of four academic years, that is, eight semesters, is the normal amount of time a student may take to earn either the Bachelor of Arts or Bachelor of Science degree. This period may be extended for one or two semesters by a student's academic dean for legitimate reasons, and if it seems probable that an extension will enable the student to complete all remaining requirements for graduation. A student will not be permitted residence of more than five academic years, that is, ten semesters, in order to be graduated.

For the minimum residence period, at least 16 courses must be satisfactorily completed at Duke. If only 16 courses are taken at Duke, they must include the courses of the final two semesters. A student with more than 16 courses at Duke may take 2 courses of the last year at another institution of approved standing. With the approval of his major adviser and his academic dean, a student who has completed six full semesters of work at Duke may take 4 courses in his last year at another institution of approved standing. Any courses taken elsewhere must be approved by the student's adviser and academic dean.

A former student of The Woman's College who has been out of college for six or more years may take up to 10 courses or 30 semester hours of work in another institution of approved standing in final fulfillment of graduation requirements. Further information about this special provision can be obtained from the Associate Dean of Trinity College of Arts and Sciences.

Quality of Work (Continuation Requirements). A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation each year to continue enrollment in college. A student who fails to meet these minimum requirements described below must leave college for at least two semesters. A summer session may be counted as a semester. He may apply to the Associate Dean of Trinity College of Arts and Sciences for readmission. If after readmission the student again fails to meet the continuation requirements, he will be permanently dismissed from the College.

Where continuation is in question, incomplete work in any course is considered a failure to achieve satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the first day of classes for the spring semester, or June 15 in the summer. In the case of incomplete work in the spring semester, this requirement applies whether or not the student plans to attend one or more terms of the summer session. However, the student may not enroll in a summer term at Duke until he has satisfied the requirement on satisfactory performance each semester.

Any student excluded from the college under the provisions of these regulations may at his request have his case reviewed by the Associate Dean of Trinity College of Arts and Sciences.

Satisfactory Performance Each Semester. To continue from one semester to a successive semester or summer session a student is expected to achieve passing grades in all courses. In the event that he does not pass all courses the following minimum requirements must be met: after the first semester of the freshman year a student who fails more than 1 course must withdraw from college; a freshman who fails more than 2 courses in his first semester must withdraw. A student who for any special reason has been permitted to enroll for fewer than 4 courses must earn all passing grades, with the exception that a freshman may continue from his first to his second semester although he may have earned a failing grade in 1 course.

Satisfactory Progress Toward Graduation. For continuation from year to year a student must make satisfactory progress toward fulfillment of curricular requirements and must pass a certain number of courses *at Duke*, as follows:

To begin enrollment in the	a student must have passed
second year	6 semester-courses
third year	14 semester-courses*
fourth year	22 semester-courses
fifth year	28 semester-courses

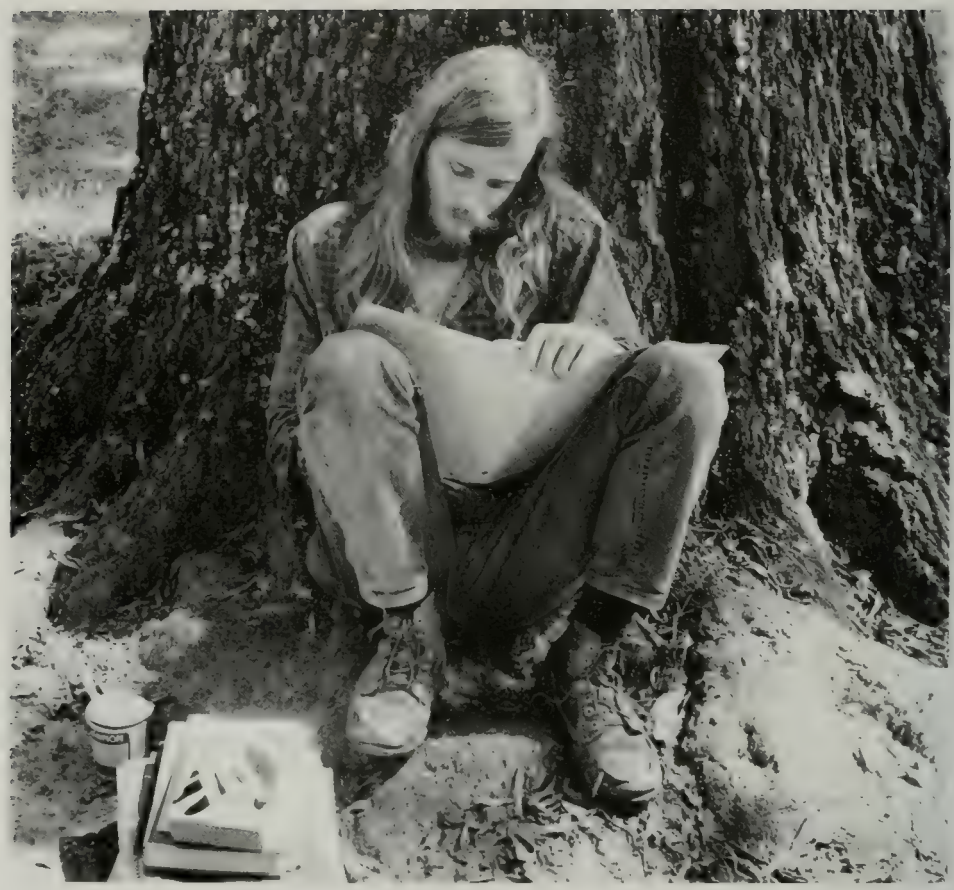
No more than 2 courses completed with *D* grades may be counted toward fulfilling the requirement. Courses in the arts and sciences taken in the summer terms at Duke may be used to meet this requirement.

PROGRAM II

Nature and Purpose. An alternate approach leading to either the A.B. or B.S. degree is Program II. This program offers the student who has an unusual interest or talent in a single field, or an unusual combination of interests or talents in several fields, an opportunity to plan and carry out a special curriculum adapted to his interests and needs. The student and a departmental Program II adviser design an individual plan of work for the whole or the remainder of the student's college career. They assess his background, needs, and ambitions and evaluate the resources of the University and those outside it as means of satisfying those ambitions. They consider what academic courses would be useful but also take into account that a full semester or year of independent study or work/study on or off campus, or a period of study abroad, might seem pertinent. Each curriculum is tailored to the special interests and talents of the student for whom it is designed. Recent topics have included Appalachian Cultural Studies, Twentieth Century Musical Composition and Conducting, Topics in Plant Physiology, and the Political Implications of Contemporary Christian Thought.

Admission. A student interested in being considered for Program II should confer with the director of undergraduate studies in the department closest to his interest. If he appears suited to Program II, the director, other adviser, or an interdepartmental committee will counsel the student concerning the design of his curriculum. When an interdepartmental committee is needed, one department will bear administrative responsibility. The curriculum

*The requirement on small-group learning experiences for the freshman-sophomore year must also be fulfilled.



must be approved by the department and also by the Committee on Program II of the Undergraduate Faculty Council of Arts and Sciences. Upon endorsement by that committee, it becomes an obligation assumed by the student, though it may later be modified with the approval of the department and the Committee on Program II. A description of the plan is sent to the student's academic dean, and each semester the student's progress in achieving the plan is also reported.

Until formally designated a student in Program II, a student should register for courses to satisfy the curricular requirements of Program I. Upon acceptance into Program II, a student is relieved of most, but not all, requirements expected of Program I students. Should he leave Program II for any reason, the student assumes all requirements of Program I.

Usually, a student will be accepted into Program II only after he has been in residence at Duke for one or two semesters. However, a transfer student or freshman who desires to be admitted in his first semester at Duke is invited to write the Office of Undergraduate Admission before matriculation, providing a statement of qualifications and plans as a prospective Program II student.

General Requirements. Apart from the requirements arising from his approved plan of work, a Program II student must satisfy certain general requirements. He must earn 32 semester-course credits for graduation and complete the requirement for physical activity (page 10). He is subject to the require-

ments on military science courses (page 12) and residence (page 12), although the requirements relating to the last two semesters may be adjusted to suit the student's approved plan of work.

UNDERGRADUATE-PROFESSIONAL COMBINATION PROGRAMS

Provisions whereby a senior may elect the work of the first year in a professional school of Duke University applies solely to *eligible students in Trinity College of Arts and Sciences.* The privilege of completing a combined course for the degree is conditional upon admission to the professional school at the close of the junior year. A student thus admitted registers as a first-year student in the professional school.

Forestry and Environmental Studies. A student who has completed three years in arts and sciences and who has maintained a satisfactory academic record may transfer to the School of Forestry and Environmental Studies providing he has the approval of his academic dean and is accepted for admission to the School. A candidate must satisfy all divisional requirements as well as the course work expected of rising seniors in his major. Upon satisfactory completion of the courses ordinarily required in the first two semesters in the School of Forestry and Environmental Studies, the student will be eligible for a baccalaureate degree from Duke University. Students in Master of Forestry programs will complete their undergraduate requirements in an initial summer session and the succeeding semester, whereas students in environmental studies will ordinarily complete their requirements in two regular semesters. The degree of Master of Forestry or of Master of Environmental Management may be earned upon satisfactory completion of three additional semesters. A student interested in this program may consult the academic dean for natural sciences in Trinity College of Arts and Sciences and the Dean of the School of Forestry and Environmental Studies.

Law. A student with a distinguished academic record who has completed three years of undergraduate work, or is within two semesters of graduation, including the course requirements for the A.B. degree and work in the junior year in his major and related fields, may, with the approval of his academic dean, apply for admission to Duke University School of Law. If admitted he will be eligible for the A.B. degree from Duke University upon completion of the work of the first year in the Law School. Only students with records of unusual academic excellence will be considered for admission to the Law School after completion of the junior year.

Medicine. The B.S. or A.B. degree may be awarded to certain students who successfully complete (1) 24 courses of undergraduate study in an approved curriculum within arts and sciences at Duke University and (2) the first year of medical study in the Duke Medical School. Such candidates are to satisfy the requirements of a departmental or interdepartmental major as well as divisional requirements, or to complete satisfactorily an approved curriculum in Program II. Candidates must apply for approval through the Dean of Trinity College of Arts and Sciences after two years at Duke, but before transfer to the Medical School.

PREPARATION FOR GRADUATE AND PROFESSIONAL SCHOOLS

At the earliest opportunity a student planning to enter a graduate or professional school should consult his academic dean and faculty adviser. Since many graduate and professional schools require special tests for students

seeking admission, he should also obtain information regarding the requirements from the catalogues of the schools to which he plans to apply. The University Counseling Center will provide applications for the testing programs.

Graduate Schools of Arts and Sciences. As soon as practicable, the student should ascertain the requirements of the particular graduate school he desires to enter and should consult an adviser in the field of the proposed advanced study concerning preparation. Most graduate schools have requirements in foreign languages, and candidates for the degree of Doctor of Philosophy may be required to pass reading examinations, usually in German and French.

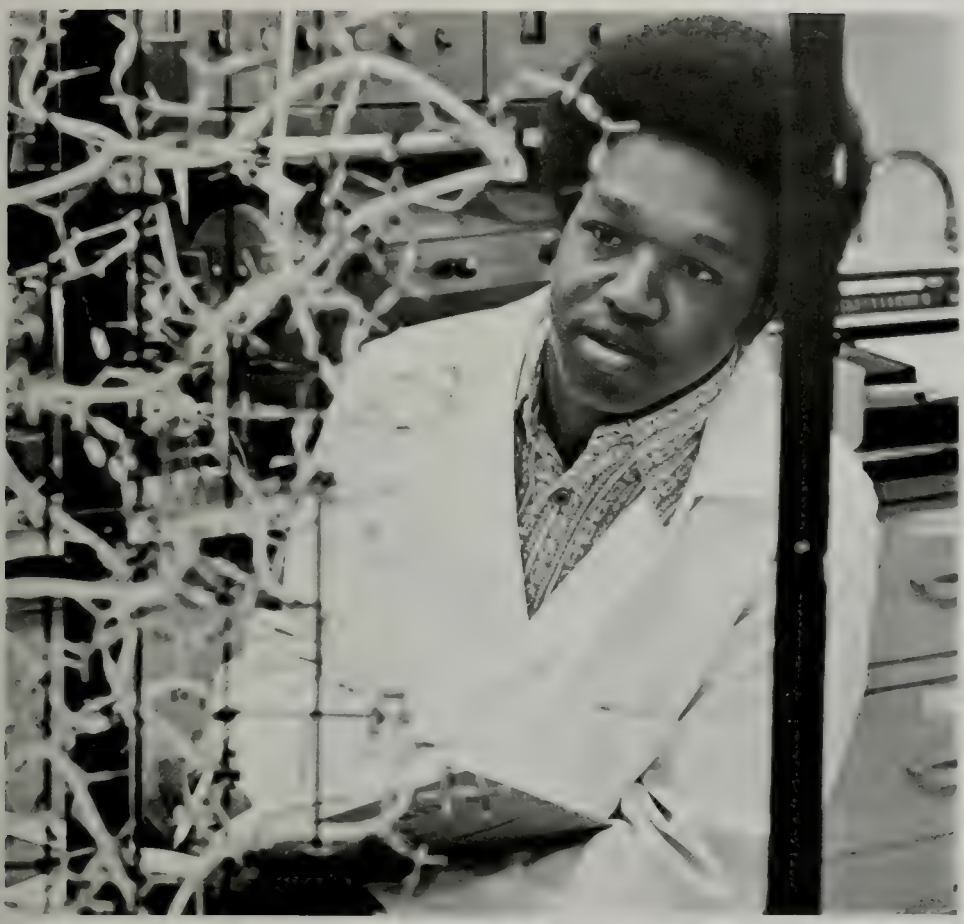
Graduate Schools of Engineering. Students interested in the possibility of graduate work in engineering should consult the Dean of the School of Engineering or the director of graduate studies in one of the engineering departments. Most engineering graduate schools require that a candidate have the equivalent of a Bachelor of Science in Engineering degree; however, students in the natural and social sciences may obtain conditional admission if they have a sufficient background in mathematics and a desire to apply science to the solution of problems.

Graduate Schools of Nursing. Students interested in attending either graduate or post-baccalaureate programs in nursing should consult their faculty advisers, the Director of Academic Programs, or the Dean of the School of Nursing.

Graduate Schools of Business Administration. Students seeking advice concerning preparation for graduate school in business administration may consult the Department of Management Sciences or the College's adviser for graduate business programs. Many graduate programs in business administration are designed specifically for students with little or no undergraduate work in business. Some schools require at least one year of calculus for admission. Additional courses in mathematics can be helpful, especially linear algebra, probability, statistics, and advanced calculus. Other areas in which work can be of special value are philosophy of science and formal logic, one or more of the behavioral sciences, economics, the physical sciences, and engineering.

Medical and Dental Schools. Students planning to enter schools of medicine, dentistry, or veterinary medicine can prepare for admission by completing any of the regular departmental majors in Program I, or by Program II, and by taking those courses required by the professional schools of their choice. Virtually all medical schools and most schools of dentistry and veterinary medicine require the same basic group of college premedical courses: a year of biology, a year each of inorganic and organic chemistry, and a year of general physics. In addition many schools require a year of English and a few require a foreign language. About a third of all medical schools now require a year of calculus and some suggest courses in statistics. For a complete listing of these and other requirements set by each medical school, see *Medical School Admissions Requirements*, published annually by the Association of American Medical Colleges. Current copies, as well as information concerning careers in dentistry, veterinary medicine, osteopathic medicine, and many allied health professions, are available in the Office of the Premedical Adviser. Students should discuss their programs of study with their major adviser, academic dean, and with the premedical adviser.

Law Schools. Students who plan to prepare for law school should seek breadth in their undergraduate course program with specialization in one or



more areas. They may choose virtually any field for their major work. Though no specific courses are required, prelaw students have often chosen from among the following courses: Management Sciences 100; Economics 51, 52; English 55, 56; History 21 and 22, 91 and 92, 105, 106; Philosophy 41 and 48; Political Science 61; Sociology 91; Engineering 169, 170.

For a fuller discussion of undergraduate preparation for the study of law, students should refer to the *Bulletin of the School of Law* or consult with the College's prelaw adviser.

Theological Schools and Religious Work. The student contemplating theological study should correspond at the very earliest opportunity with the school or schools to which he intends to apply and with the authorities of his church in order to learn what will best prepare him for the specific program he expects to enter. He will likely find that he should consider the following subjects: English language and literature; history, including non-Western cultures as well as European and American; philosophy, particularly its history and its methods; natural sciences, both the physical and the life sciences; psychology, sociology, and anthropology; the fine arts and music; Biblical and modern languages; religion, both in the Judaeo-Christian and in the Near and Far Eastern traditions. Some seminaries require Greek or Hebrew for admission. It is the understanding gained in these fields rather than the total of credits or semester hours earned which is significant.

The School of Engineering

Duke University offers in the School of Engineering programs of study which lead to the degree of Bachelor of Science in Engineering (B.S.E.), with majors in the Departments of Biomedical, Civil, and Electrical Engineering, and the Department of Mechanical Engineering and Materials Science. Special programs of study in interdisciplinary fields (see page 25) leading to the B.S.E. degree may be arranged with approval of the engineering faculty. The four curricula in the engineering departments are accredited by the Engineers' Council for Professional Development.

For graduation with a Bachelor of Science in Engineering degree, a student must complete successfully a minimum of 32 semester-courses. These 32 semester-courses must include the following:

General Requirements

English .....1 s.c.	This requirement is met by completing English 1.
Mathematics .....4 s.c.	This requirement is met by completion of Mathematics 31, 32, 103, and 104 or 111.
Natural Science .....3 s.c.	This requirement is met by completing Chemistry 11 and Physics 51 and 52.
Social Sciences and Humanities .....4 s.c.	This requirement is met by completion of 4 courses from at least two departments in the humanities and social sciences. This program of courses should reflect a rationale or fulfill an objective appropriate to the engineering profession. Courses selected must be those which present essential subject matter and substance of the discipline; for example, no introductory skill courses may be used to satisfy this requirement. Likewise, courses devoted primarily to subjects such as accounting, industrial management, finance, personnel administration, introductory language, and ROTC normally do not fulfill this objective regardless of their general value in the total engineering curriculum. House courses may not be used to satisfy this requirement.
Engineering and Applied Sciences 4 s.c.	This requirement is met by completion of at least 1 course from each of four of the following six areas: electrical science, information and computer science, materials science, mechanics (solid and fluid), systems analysis, and thermal science and transfer processes. See departmental requirements, which follow, for any specific courses to be included.



Digital Computation ..... Students are expected to have acquired a digital-computer programming capability before their sophomore year. The programming capability may be satisfied by prior experience or by passing Engineering 31, Mechanical Engineering 31, or Computer Science 51.

Departmental Requirements

Departmental Specifications ..16 s.c. The department administering the major field of study will specify the nature of this requirement. In general it will consist of both required courses and electives to be planned in consultation with the departmental adviser. See the individual departmental requirements, which follow.

*Total Minimum Requirement ....32 s.c.

*A maximum of 2 semester-courses of junior or senior level air science or naval science course work may be counted in satisfying the minimum requirements of 32 semester-courses for a baccalaureate degree in engineering. These courses must be included in the 17 semester-courses listed under departmental requirements. All other courses completed in air science or naval science are taken in addition to the minimum program.

Program of Studies for the Freshman Year

First Semester	*Courses*	*Second Semester*	*Courses*
Chem. 11—Principles of Chemistry	1	Physics 51—General Physics	1
English 1—Freshman Composition	1	Math. 32—Introductory Calculus	1
Math. 31—Introductory Calculus	1	Elective†	1
Elective†	1	Elective†	1
	4‡		4‡

†Each student is encouraged to plan a program designed for his individual needs. His faculty adviser will be available to assist him beginning with the opening of Freshman Week. Advice should be sought relative to the most effective use of electives in relation to the special requirements of the various engineering majors.

It should be noted that students are expected to have acquired a digital-computer programming capability before their sophomore year.

‡The normal load each semester is 4 courses (or an equivalent combination of courses). This is the minimum program ordinarily permitted. Engineering students taking air science or naval science may need to schedule a course in military science as a supplement to the normal load.

Biomedical Engineering Departmental Requirements

The general requirements and departmental requirements are all incorporated in the following sequence. This is only one of several possible sequences. The student is encouraged to choose electives and select a sequence which develops broad intellectual interests.

Freshman Year

First Semester	*Courses*	*Second Semester*	*Courses*
Chem. 11—Principles of Chemistry	1	Chem. 12—Principles of Chemistry	1
English 1—Freshman Composition	1	Biology 14—Introduction to Biology	1
Math. 31—Introductory Calculus	1	Math. 32—Introductory Calculus	1
Computer Science 51—Introduction to Digital Computation	1	Social Science or Humanities Elective	1
	4		4

Sophomore Year

First Semester	*Courses*	*Second Semester*	*Courses*
Physics 51—General Physics	1	Physics 52—General Physics	1
B.M.E. 71—Discrete-Systems Analysis	1	E.E. 63—Electric Networks	1
Math. 103—Intermediate Calculus	1	Math. 104—Linear Algebra and Applications	1
Zoology 151—Principles of Physiology	1	Social Science or Humanities Elective	1
	4		4

Junior Year

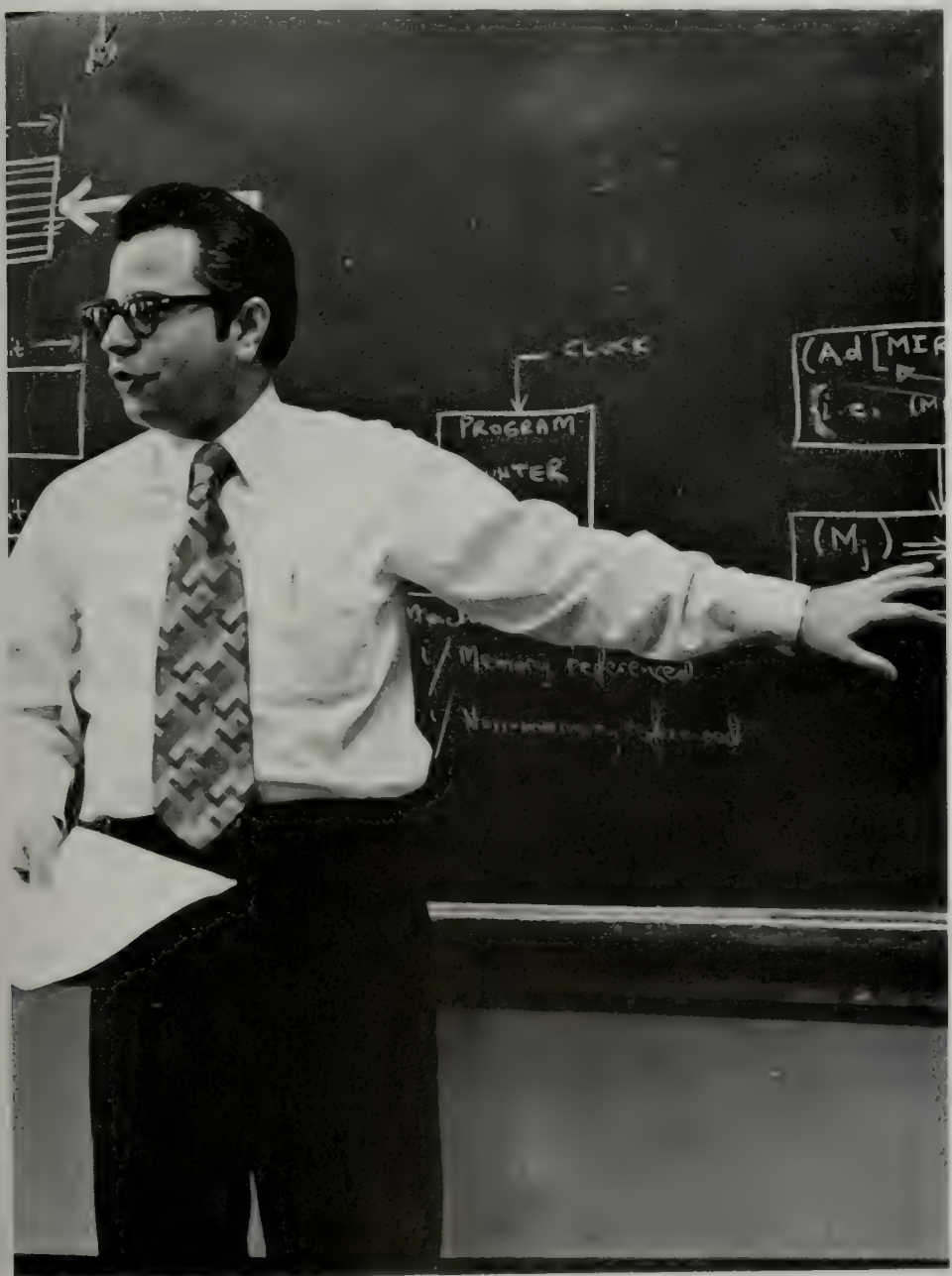
First Semester	*Courses*	*Second Semester*	*Courses*
B.M.E. 163—Biomedical Electronics and Measurements	1	B.M.E. 164—Biomedical Electronics and Measurements	1
Engineering 135—Mechanics	1	B.M.E. 125—Mechanics of Biological Materials	1
Math. Elective*	1	Approved Elective	1
Approved Elective	1	Approved Elective	1
	4		4

*Mathematics 135 is recommended.

Senior Year

First Semester	*Courses*
M.E. 126—Fluid Mechanics	1
Approved Elective	1
Approved Elective	1
Social Science or Humanities Elective	1
	4

Second Semester	*Courses*
B.M.E. 172—Biomedical Transfer Processes	1
Approved Elective	1
Approved Elective	1
Social Science or Humanities Elective	1
	4



Civil Engineering Departmental Requirements

The general requirements and the departmental requirements are all incorporated in the following typical program.

Freshman Year

First Semester	*Courses*	*Second Semester*	*Courses*
Chem. 11—Principles of Chemistry	1	†C.E. 16—Surveying for Engineers	½
English 1—Freshman Composition	1	†Engineering 11—Engineering Graphics	½
Math. 31—Introductory Calculus	1	Physics 51—General Physics	1
Engineering 31—Computers in Engineering	1	Math. 32—Introd. Calculus	1
		‡Approved Elective	1
	4		4

Sophomore Year

First Semester	*Courses*	*Second Semester*	*Courses*
Engineering 75—Mechanics of Solids	1	Engineering 83—Structure and Properties of Solids	1
Math. 103—Intermediate Calculus	1	Engineering 123—Dynamics	1
Physics 52—General Physics	1	Math. 104—Linear Algebra or Math. 111—Applied Math. Analysis I	1
‡Approved Elective	1	‡Approved Elective	1
	4		4

Junior Year

First Semester	*Courses*	*Second Semester*	*Courses*
C.E. 131—Structural Analysis I	1	C.E. 123—Water Resources Engineering	1
Engineering 145—Fluid Mechanics	1	§C.E. 133—Structural Design I	1
*Engineering Science Elective	1	C.E. 139—Soil Mechanics	1
‡Approved Elective	1	‡Approved Elective	1
	4		4

Senior Year

First Semester	*Courses*	*Second Semester*	*Courses*
C.E. 124—Environmental Engineering	1	C.E. 116—Transportation Engineering	1
§C.E. 134—Structural Design II	1	‡Approved Elective	1
‡Approved Elective	1	‡Approved Elective	1
‡Approved Elective	1	‡Approved Elective	1
	4		4

*Electrical Engineering 43, Engineering 72, or Engineering 104.

†May be taken in the fall or spring of the freshman or sophomore year.

‡Part of a program of elective courses planned with departmental approval to suit the interests and abilities of the individual student. In addition to satisfying the social science-humanities requirement of the School of Engineering, the program must include a minimum of one elective course in natural science. The program should also include a minimum of three *emphasis electives* which are designed to reinforce the student's major area of study. One emphasis elective must be a civil engineering course.

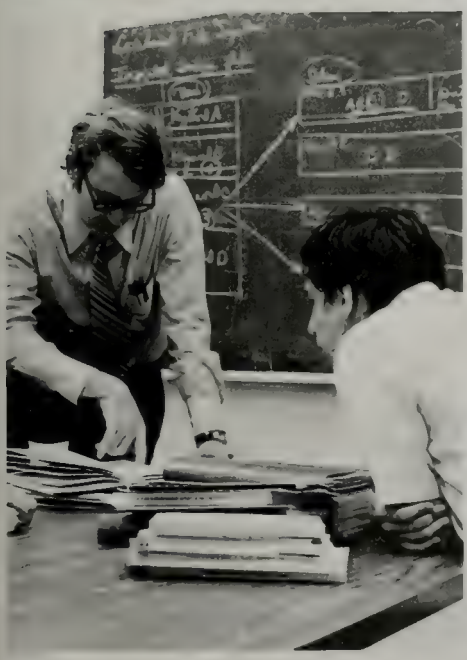
§C.E. 133 or C.E. 134 may be replaced by an approved Civil Engineering design elective.

Electrical Engineering Departmental Requirements*

Mathematics	1 s.c.	Mathematics elective beyond Math. 104 or 111.
Basic Science	1 s.c.	Basic science elective (in addition to 3 s.c. in natural science listed under general requirements).
Social Sciences and Humanities	2 s.c.	Social sciences-humanities elective (in addition to 4 s.c. listed under general requirements).
Courses in Major	1 s.c.	E.E. 113—Introductory Systems Theory.
	5 s.c.	E.E. electives at the 100-level or above.
Approved Electives	1 s.c.	Must be an engineering science course taught within the School of Engineering.
Approved Electives	2 s.c.	Must be in engineering science, physical science, computer science, or mathematics.
Approved Electives	4 s.c.	
Other courses	15 s.c.	Listed under general requirements.

*One of the 4 courses in engineering and applied sciences as listed under general requirements must be Electrical Engineering 63.







Mechanical Engineering and Materials Science Departmental Requirements

The general requirements and departmental requirements are all incorporated in the following typical program.

Freshman Year

First Semester	*Courses*	*Second Semester*	*Courses*
Chem. 11—Principles of Chem.	1	*Engineering Science Elective	1
Engineering 31—Computers in Engineering	1	Math. 32—Introductory Calculus	1
Eng. 1—Freshman Composition	1	Physics 51—General Physics	1
Math. 31—Introductory Calculus	1	†Approved Elective	1
	4		4

Sophomore Year

First Semester	*Courses*	*Second Semester*	*Courses*
*Engineering Science Elective	1	*Engineering Science Elective	1
Math. 103—Linear Algebra and Intermed. Math. Analysis	1	Math. 111—Applied Math. Analysis	1
Physics 52—General Physics	1	†Approved Elective	1
†Approved Elective	1	†Approved Elective	1
	4		4

Junior Year

First Semester	*Courses*	*Second Semester*	*Courses*
M.E. 101—Thermodynamics	1	M.E. 136—Response of Systems	1
M.E. 123—Dynamics	1	‡M.E. 150—Heat and Mass Transfer	1
‡M.E. 126—Fluid Mechanics	1	†Approved Elective	1
†Approved Elective	1	†Approved Elective	1
	4		4

Senior Year

First Semester	*Courses*	*Second Semester*	*Courses*
M.E. 141—Mechanical Design I	1	§Advanced Technical Elective	1
§Advanced Technical Elective	1	§Advanced Technical Elective	1
§Advanced Technical Elective	1	†Approved Elective	1
†Approved Elective	1	†Approved Elective	1
	4		4

*The 4 courses in engineering sciences must be Engineering 72, 75, and 83, and Mechanical Engineering 101.

†Part of a program of elective courses planned with departmental approval to suit the interests and abilities of the individual student. Included in these approved electives must be 5 social science-humanities courses, 1 elective course in natural science, and Math. 104 or a mathematics course beyond Math. 111. Mechanical Engineering 65 is recommended during the second semester, freshman year.

‡Students specializing in materials science may substitute both M.E. 111 and Engineering 122 for M.E. 126 and M.E. 150.

§The advanced technical electives should be chosen to emphasize a professional objective in the curriculum.

Double Major. If an engineering student satisfies the requirements of a departmental major in arts and sciences simultaneously with satisfying the requirements for a B.S.E. degree, or satisfies simultaneously the requirements for two engineering majors, his official record will indicate this fact. However, the director of undergraduate studies for the second major must certify that its departmental major requirements have been met and the student must initiate the procedure, either through the Dean of the School of Engineering or through the director of undergraduate studies in his department, and the major requirements of the second department must be confirmed no later than the time of registration for the final semester.

Courses which are common to both majors shall be counted toward satisfying the requirements of both majors.

Interdisciplinary Programs in Engineering. This major parallels the majors in biomedical, civil, electrical, and mechanical engineering and materials science. It provides for special programs of study in interdisciplinary fields, such as energy conversion, engineering mechanics, materials science, ocean engineering, pollution control, systems and controls, and urban engineering, leading to the B.S.E. degree, which may be arranged with approval of the engineering faculty. Any student, in consultation with his adviser or another faculty member, may propose a unique combination of courses designed to meet his particular career objectives. His proposal should be submitted to the Engineering Faculty Council, through the Dean of the School of Engineering, for approval; it may be submitted as early as the second semester of the freshman year and must be submitted before the beginning of the senior year. The proposal should include the student's reasons for pursuing the suggested program of study, and it must show how the proposed courses satisfy the following requirements:

1. The proposed program of study meets the general requirements for the B.S.E. degree but cannot be accommodated by the approved departmental requirements in biomedical, civil, electrical, or mechanical engineering and materials science.
2. A program of at least 8 engineering courses is included to provide depth in the selected interdisciplinary area of study.
3. A program of at least 5 courses, in addition to the 15 courses listed under general requirements, is included to provide breadth in technical (engineering, natural science, and mathematics) areas.
4. The remaining courses, which are treated as electives, require the approval of the student's adviser.

Each student enrolled in an approved interdisciplinary program will be assigned to the appropriate engineering department for administrative purposes.

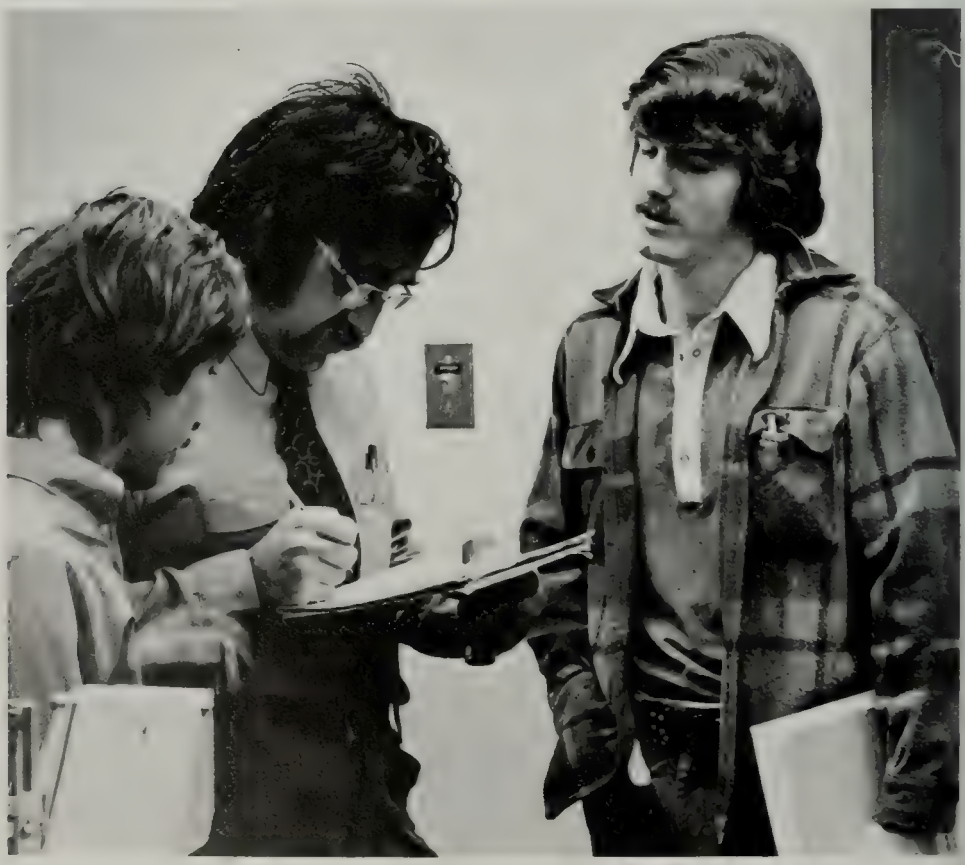
Program in Engineering and Public Policy. Engineering students may pursue a program of study leading to the degree of Bachelor of Science in Engineering, with a major in one of the five engineering fields of study and a second major in public policy studies. The program is sponsored by the School of Engineering and the Institute of Policy Science and Public Affairs. In order to qualify for a degree with this second major, a student must satisfy the requirements for one of the five engineering majors at Duke University and a series of courses, which may be characterized as electives within the engineering curriculum, that meet the requirements for the major in public policy studies. These requirements are a modified parallel of the requirements of the major in public policy studies as described on page 200.

Residence Requirements. At least 16 semester-courses must be completed satisfactorily at Duke. This must include the work of the final two semesters with the following exceptions: the student who has completed more than four full semesters of work at Duke may take the last 2 courses elsewhere; others may take 1 last course elsewhere. The courses taken elsewhere must be approved by the student's major adviser and his academic dean.

Pass/Fail Grading Option. With the consent of the instructor and the faculty adviser, an engineering student may choose to be graded on a pass/fail basis in up to four unrestricted electives or social sciences-humanities electives within the 32-course program. A student may take no more than 1 course on a pass/fail basis per semester.

Continuation Requirements. A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation to continue his enrollment in the University.

A student must pass at least 3 courses in each semester, except for the first semester of the freshman year when at least 2 courses must be passed. A student who fails to meet this continuation requirement must leave the University for at least two semesters. A complete summer session may be counted as a semester. Following a student's application for readmission, his return must be approved by the dean and the director of undergraduate studies in his major department. If the student thereafter fails to pass 3 courses in a semester, he ordinarily will be permanently dismissed from the University. A student



who enrolls in more than 4 courses in a given semester and fails 2 or more of them will not be permitted to enroll for more than 4 courses in the following semester without approval of the dean. In addition, a student may be dismissed temporarily or permanently for failing to make satisfactory progress toward graduation, including satisfactory progress toward fulfillment of curricular requirements within ten semesters.

The term *satisfactory progress* shall be defined also by the following schedule:

Semesters completed	Minimum number of semester-courses passed	Minimum number of semester-courses passed with C- or better, or P
2	6	2
4	12	8
6	18	14
8	24	20

Grade Requirements for Graduation. Of the 32 semester-courses required for graduation, 28 or their equivalent in number, must be passed with grades of C- or better.

The School of Nursing

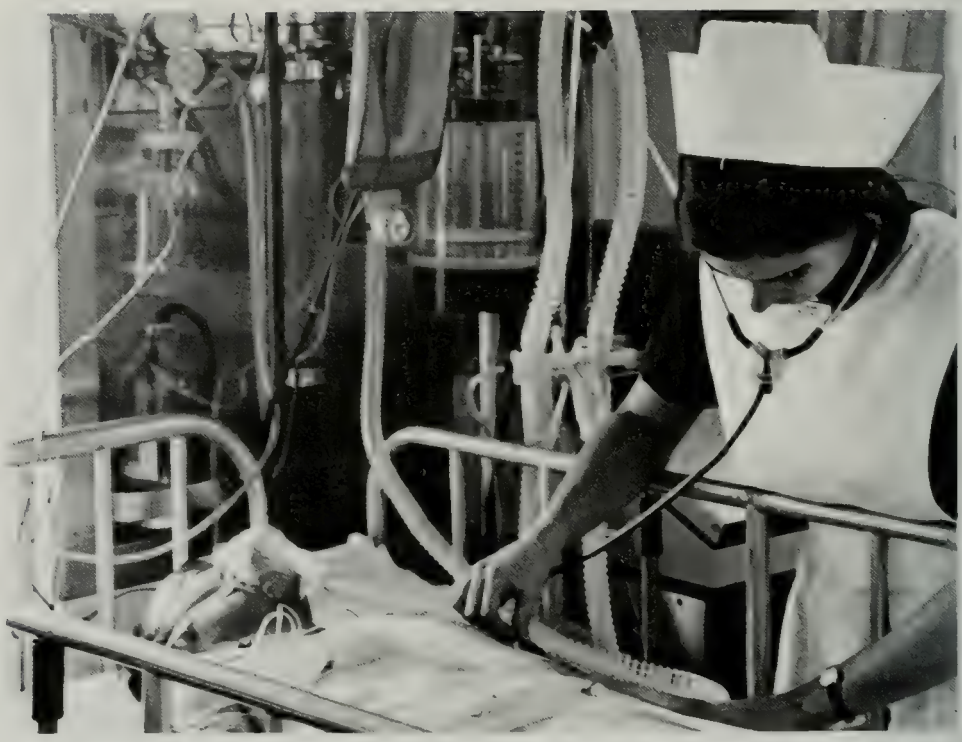
The baccalaureate program is designed to produce a professional nurse who:

1. comprehends and appreciates man's opportunities, responsibilities, and relationships in a dynamic environment.
2. develops knowledge, comprehension, and skills essential to the process of nursing.
3. develops knowledge and comprehension of a professional role within a social, biological, and cultural framework.
4. develops a foundation for potential social sensitivity and the desire for continuous self-development and fulfillment.

The overall goal of the curriculum is to prepare students to assume responsibilities as professional nurses and well-educated individuals. The course of study with its flexible approach prepares practitioners to begin to function as professionals in nursing services for individuals, families, and communities.

The curriculum provides a base for professional growth; the knowledge, skills, and appreciations characteristic of those with a liberal education; and a foundation for graduate study. Studies in the freshman and sophomore years are devoted primarily to the liberal arts and basic sciences; during these years, cocurricular activities are provided to introduce the students to nursing. The focus of the junior and senior years is the nursing major. Transfer students can be readily accommodated in a curriculum of this design.

The students are seen as aggressive, active participants in making decisions about their own learning needs and interests. They are enabled and encouraged to plan a program of study compatible with their background and interests which will contribute to their personal and professional goals. With the guidance of academic advisers, students may elect courses and experiences which best serve their interests for concentration on an area of study or for



exploration in several fields. Teaching techniques take into consideration the spontaneity, potential, and individuality of the student.

The distinctive features of the curriculum are:

1. Although every student acquires a base in the natural and social sciences and humanities, students may choose to develop a second major in any of these three areas.
2. The conceptual framework of the curriculum is the nursing process. Students augment, complement, and integrate social, biological, and psychological theories and experiences as they use the nursing process in the care of individuals in need of health care.
3. Through courses comprising the professional nursing component, opportunities are provided for the student to progress in uniting knowledge and decision-making with nursing action concerning individuals, groups, and families whether they be hospitalized or in the community.
4. Nursing electives and independent study in the upper division permit students to pursue individual interests, to broaden their scope of nursing, and to gain a degree of proficiency in the type of initial professional practice in which they wish to engage after graduation.
5. The curriculum is theoretically oriented in the belief that students who learn to select facts and theories from relevant disciplines for application to nursing practice will be able to adapt readily to changing modalities of health care.

Program of Study. For graduation with a Bachelor of Science in Nursing degree a minimum of 32 semester-courses plus 2 courses in physical education activity must be completed successfully. The courses are divided into lower and upper divisions with 12 upper division courses in nursing required for the nursing major.

Lower Division

Natural Science	2 s.c.	In sequence.* May select from chemistry, botany, zoology, physics, geology, or biology.
Human Ecology I, II	2 s.c.	N97, N98
Statistics	1 s.c.	Any introductory course offered by the School of Nursing or by Departments of Mathematics, Psychology, or Economics.
Social Sciences	3 s.c.	One course must be in psychology and the other two may be: a. one in psychology and one in sociology or anthropology b. two in sociology c. two in anthropology d. one in sociology and one in anthropology.
Humanities	1 s.c.	No skill courses satisfy this requirement. (See page 9.)
English Composition	1 s.c.	English 1 (See page 9.)
Electives	6 or 7 s.c.	
Physical Activity	2 s.c.	No credit (See page 12.)

*Exception is made to the "in sequence" requirement if the student takes Biology 14, which is only one course. In this case the student must select another botany or zoology course to complete the requirement.

Students must satisfy the small-group learning experience requirements during the first two years, as outlined for students in the arts and sciences on page 8.

Upper Division

Theoretic and Scientific Bases for Nursing Practice	2 s.c.
Development of Nursing Skills and Attitudes	4 s.c.
Distributive and Episodic Nursing Practice	4 s.c.
Functional Aspects of Nursing Practice	1 s.c.
Required Independent Study	1 s.c.
Electives (includes optional independent study)	4 s.c.

A student desiring to complete requirements for a second major in department of arts and sciences may do so and have both majors entered on the official record. (See page 39.)

Continuation Requirements. A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation to continue his enrollment in the School of Nursing. A student who fails to meet the minimum requirements outlined below must leave the University for at least two semesters. A summer may be counted as a semester. Following a student's application for readmission, his return must be approved by the Dean of the School of Nursing. A student who is readmitted after having withdrawn voluntarily or involuntarily for academic reasons must make no grade lower than C- during the first semester in order to continue in school.

Satisfactory Performance Each Semester. To remain in the School of Nursing, a student must not fail 3 or more courses in the first semester of the freshman year or fail 2 or more courses in any subsequent semester. An exception to this policy applies when a student fails a required nursing course worth 2 courses.

Satisfactory Progress toward Graduation. A student must pass in the approved nursing curriculum at Duke the following number of semester-courses (or their equivalent in half-courses or double-courses) to continue from one academic year to a subsequent year. (Summer terms *at Duke* may be used to meet this requirement.)

To begin enrollment in the	a student must have passed
second year	6 semester-courses
third year	14 semester-courses
fourth year	22 semester-courses
fifth year	28 semester-courses

Students are reminded that in cases where continuation is in question, incomplete work in any course is counted as a failure to achieve satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the opening of the spring semester or June 15 in the summer. In the case of incomplete work in the spring semester, this requirement applies whether or not the student plans to attend one or more terms of summer session.

Any student excluded from the School of Nursing under the provisions of this regulation may at his request have his case reviewed by the Undergraduate Studies Committee of the School of Nursing.

A minimum of 14 courses must be passed before a student can proceed to the upper division professional curriculum. Twelve of these courses must have been passed with a grade of C- or better. With the exception of transfer students, all lower division requirements must be met before entry to the upper division.

Requirements for Degree. To be graduated a student must pass a total of 32 courses (or an equivalent combination of courses, half-courses, and double-courses), including courses in the approved curriculum. 14 courses must be passed at the advanced level. Of the 32 courses required for graduation, no more than 2 courses with D grades will be accepted. Only required and elective nursing courses with a grade of C- or better will be accepted toward graduation. It is required that for graduation the student have an overall C average or better in nursing courses.

Satisfactory completion of one year of physical activity is required for graduation unless a student is excused for medical reasons. This requirement can be met by satisfactory completion of one year in appropriate physical education courses or by an alternate form of physical activity approved by the ap-

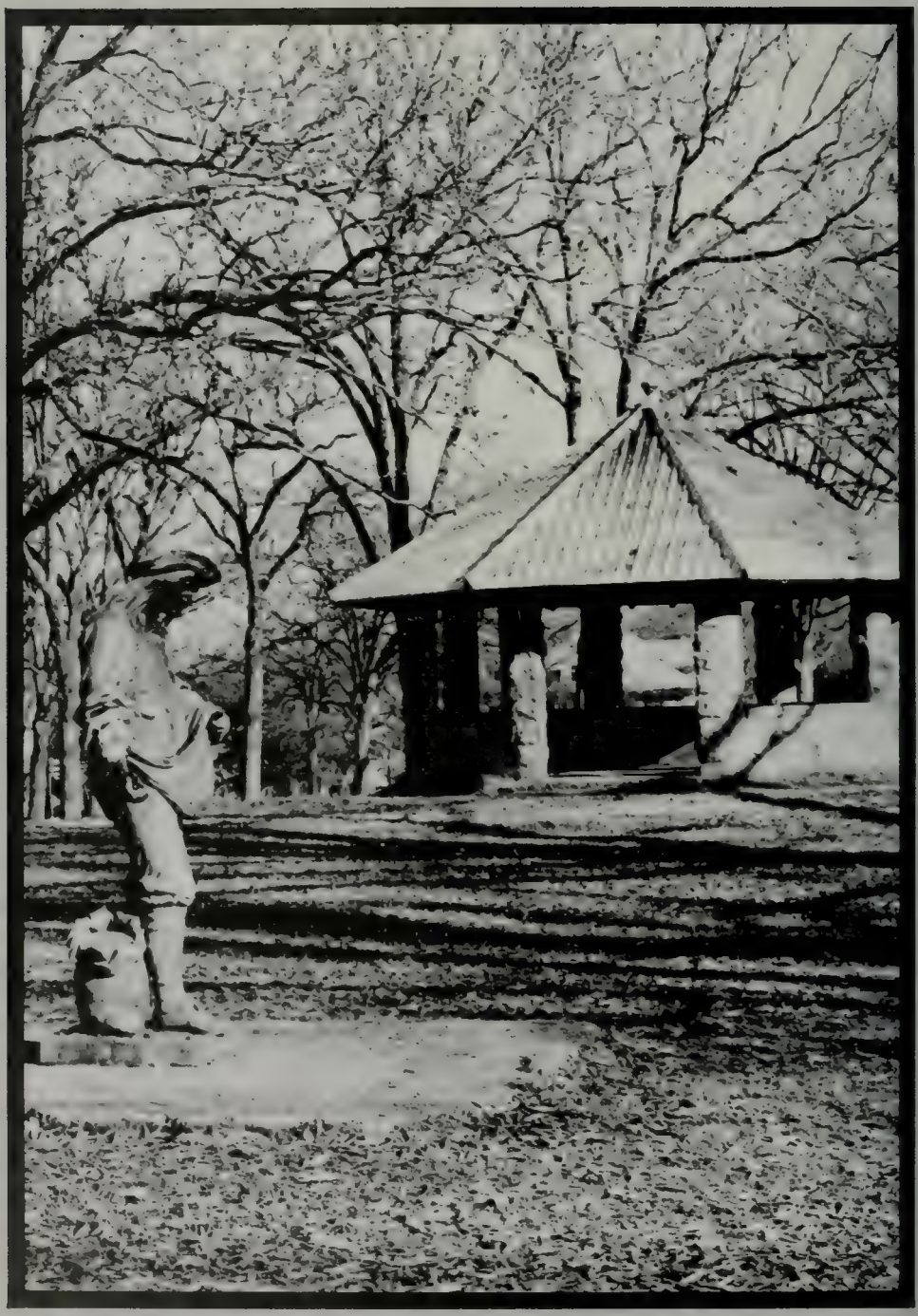
propriate physical education department. Pass/fail grades are assigned for performance in required physical education courses and for alternate forms of physical activity. Physical education courses or alternate forms of physical activity do not count among the 32 courses needed for graduation.

Residence Requirements. The requirements for the normal and maximum period of residence for students enrolled in the School of Nursing are the same as for those in Trinity College of Arts and Sciences (see page 12). However, the minimum time that any student may spend in residence (full-time study) at Duke before receiving a Bachelor of Science in Nursing degree is one year unless the student is a registered nurse completing the requirements for a B.S.N. degree. For these students full-time and part-time study are possible.

Transportation Required. The use of facilities other than Duke and Veterans Administration Hospitals requires transportation. It is the responsibility of each nursing student to provide a means of transportation to and from the facilities selected for learning experiences in both the junior and senior years. Although a few agencies may be within bicycling distance, most are not, and Durham's bus service is spaced at long intervals.

Accreditation. In addition to the accreditation status accorded the University, the School of Nursing's undergraduate program is accredited by the National League for Nursing and the North Carolina Board of Nursing.





Academic Procedures and Information



Advanced Placement

Scores on the tests discussed below and documented previous educational experience are the criteria used to determine a student's qualifications for certain advanced courses.

CEEB Advanced Placement Program (APP) Examinations. Scores of 3, 4, or 5 on CEEB Advanced Placement Program Examinations are bases for consideration for credit and placement in advanced courses in art, botany, chemistry, English,* French, German, history, Latin, mathematics, music, physics, Spanish, and zoology. A student presenting such a score and desiring to continue in the same subject at Duke may request placement in an advanced course. In the case of French, German, Latin, and Spanish, APP scores of 3, 4, or 5, may result in placement in courses at the 100-level; approval of the director of undergraduate studies or supervisor of freshman instruction in the appropriate department is required before final placement is made. Credit may be granted for 1 or 2 courses in each subject area with the approval of the academic department concerned. A student who has earned a score of 3 must complete a specified course in that subject with a grade of C or better before credit is awarded. Pass/fail grading is *not* an option for such courses. Ordinarily, the validating course must be completed by the end of the sophomore year.

CEEB Achievement Tests. Scores on CEEB Achievement Tests are the basic criteria for placement in French, German, Italian, Spanish, Latin, and mathematics, and students who present a score of 700 or higher on the CEEB English Composition Achievement Test are excused from the course in English composition required for graduation. Course credit, however, is not given for courses bypassed. The following tables will assist students in making reasonable course selections in the subjects indicated.

*These scores, though admitting a student to advanced courses in literature, do not satisfy the requirement in composition. See section on CEEB Achievement Tests.

French‡	
CEEB Achievement Scores	*Course Placement*
200-390	French 1-2
400-490	French 63
500-550	French 74, 76
560 plus	French 100-level course

German	
CEEB Achievement Scores	*Course Placement*
200-360	German 1*
370-560	German 63
570 plus	Third year†

Italian	
CEEB Achievement Scores	*Course Placement*
200-390	Italian 1-2
400-500	Italian 63
510-550	Italian 74, 76
560 plus	Italian 100-level course

Spanish‡	
CEEB Achievement Scores	*Course Placement*
200-450	Spanish 1-2
460-550	Spanish 63
560-600	Spanish 74, 76
610 plus	Spanish 100-level course

Latin	
CEEB Achievement Scores	*Course Placement*
200-520	Latin 1*
530-630	Latin 63
640 plus	Third year†

Mathematics	
CEEB Achievement Scores	*Course Placement*
Less than 530	Math. 19
530-800	Math. 31
760-800	Math. 31X, upon request of the student
600-800	Math. 33

*The first year of a language may *not* be taken for credit by a student who has completed more than two years of that language in secondary school. In rare cases, an exception may be granted with permission of the director of undergraduate studies in the appropriate department.

†An exception may be granted in consultation with the director of undergraduate studies.

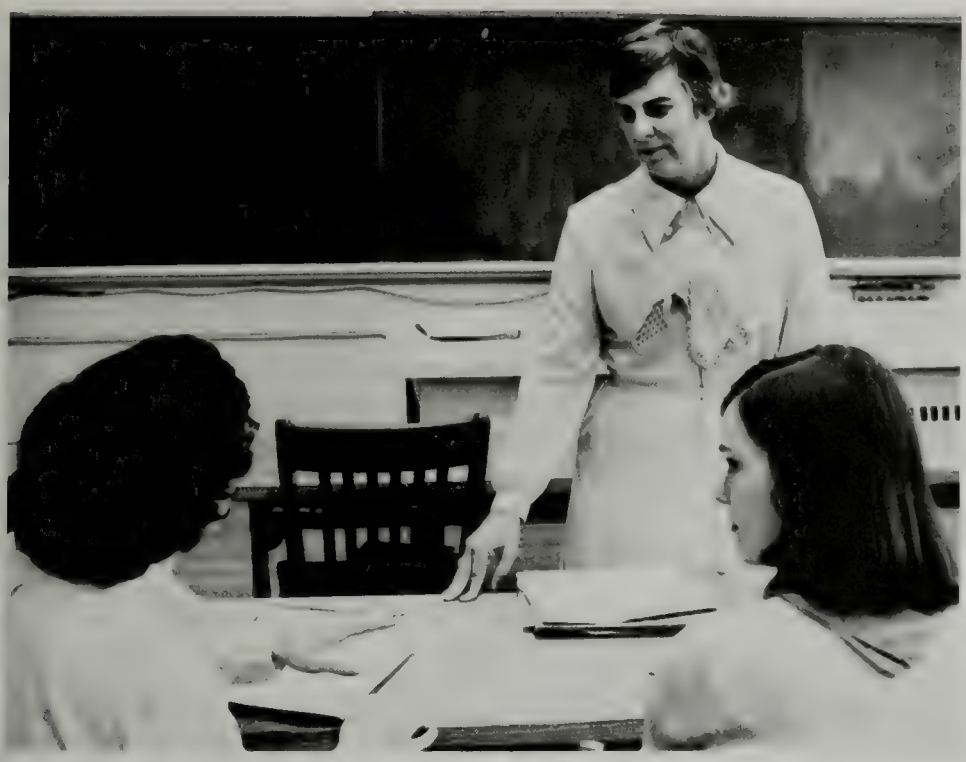
‡In these languages students are permitted to drop back one level without loss of credit (e.g., from 101 to 74 or from 74 to 63). No credit will be allowed for courses two levels below the achievement score (e.g., students with a score of 610 in French or Spanish could not receive credit for 63, but could for 74 or 76). In no case will credit be given for 1-2 to students with 3 or more years of high school French or Spanish.

CEEB College Placement Tests. The CEEB Placement Tests in French, German, Italian, Latin, and Spanish should be taken during the orientation by (1) those students who desire to continue in the language but have not taken the CEEB Achievement Test, and by (2) those students who, having taken the CEEB Achievement Test, wish to challenge the score for the purpose of qualifying for a higher level language course. These tests are also administered at the end of each semester and at the close of the first term of the summer session for the convenience of those students who wish to demonstrate their foreign language proficiency by this means.

All freshmen who plan to take mathematics during their first semester at Duke, and who did not submit the CEEB SAT score or CEEB Achievement Test score in mathematics, must take the CEEB College Placement Test in mathematics during orientation. Students who have been placed in Mathematics 19 or 31 but believe their mathematics background justifies a higher course placement need not take the CEEB College Placement Test, but should consult the Director of Undergraduate Studies of the Department of Mathematics.

Course credit is not given for courses bypassed on the basis of the placement tests.

Placement in Russian. Students who wish to continue in Russian at Duke should see the Director of Undergraduate Studies in the Department of Slavic Languages and Literature. In the case of Russian, neither CEEB Achievement



Test scores nor CEEB College Placement Test scores have been sufficiently validated to serve as criteria for placement. Therefore, the department offers an examination which is used in conjunction with other criteria for placing students at the appropriate course level.

Reading-Out of Introductory Courses. A student demonstrating academic ability may be granted the option of "reading-out" of an introductory or prerequisite course in order to allow him to advance at his own pace to upper-level work. No course credit may be earned by "reading-out." Reading for a course and auditing are mutually exclusive procedures. A student must be recommended for the reading option by his academic dean, and the proposed program of reading must be approved by the appropriate director of undergraduate studies. On passing a qualifying examination prepared by the department, a student may be certified for advanced course work. On completion of an advanced course, an entry will be made on his permanent record that he passed the qualifying examination, but no course credit is awarded. Further information is available from an academic dean.

Placement in Nursing. Registered nurses wishing to complete requirements for the Bachelor of Science in Nursing degree or students wishing to transfer nursing courses from other schools of nursing should see the Director of Academic Programs of the School of Nursing. Examinations and other criteria are used to determine appropriate placement in the approved curriculum.

Transfer Credit. Credit of up to 16 semester-courses may be granted for course work satisfactorily completed at other accredited, degree-granting institutions. Courses in which grades of less than C- have been earned are

not accepted for transfer credit. The semester-course credit unit awarded at Duke for satisfactorily completed courses cannot, of course, be directly equated with semester-hour or quarter-hour credits. Ordinarily, a transfer student will not be awarded more than 4 semester-course credits for one semester's work unless he has satisfactorily completed more than the normal course load at the institution from which he transfers. All courses approved for transfer are listed on the student's permanent record at Duke, but grades earned are not recorded.

Courses taken at other institutions are evaluated by the University Registrar. Credit for courses in science, mathematics, and foreign language taken at a junior college may also be evaluated by the Duke departments concerned, as are some courses that have no Duke equivalents.

No credit is given for work completed by correspondence. Credit for no more than 2 semester-courses is allowed for extension courses.

Advising

A student and his adviser confer as desired, but always before registration periods to review the student's goals, plans for achieving them, and any problems encountered or anticipated. Until a student declares a major he confers with his freshman adviser, freshman dean, or the academic dean in the division of his interest. Upon declaring a major the student is assigned a departmental adviser. The academic dean for his division is also available for consultation. Much good advising is informal and occurs in conversation with members of the faculty.

Registration

Students are expected to register at specified times for each successive semester. Prior to registration each student receives special instructions and registration materials. He prepares a course program and presents it at an appointed time to his adviser for review. The approved schedule is then presented at registration.

Students who expect to teach in elementary or secondary schools should consult an adviser in the Department of Education prior to each registration period to ensure that they are meeting requirements for certification (many states have unique requirements) and that they will have places reserved in the student teaching program.

Those who register at a time later than the day specified in the University calendar are subject to a $10 fine. Students who fail to register are withdrawn and must apply for readmission if they wish to return; they also forfeit their $50 registration deposits unless they indicate at the time of registration their intention not to continue in the University the following semester.

Semester Opening. Students are expected to report to a designated office at the beginning of each semester to obtain a semester enrollment card. Any student who is unable to do so should notify his academic dean that he will be late in arriving. Failure to report, or to account beforehand for one's absence, entails a loss of registration in courses. Official enrollment is required for admission to any class.

Course Changes After Classes Begin. During the drop/add period a student may make changes in his schedule. Course changes initiated by the student entail a fee of $1 per change. Students are reminded that it is their responsibility to be certain that their course load conforms with the academic requirements.

In Trinity College of Arts and Sciences students may drop and add courses during the first week of classes at their own discretion. During the remainder of the drop/add period they may drop courses at their own discretion, but the signature of the appropriate instructor is required for adding courses. After the drop/add period no course may be added, and in order to withdraw from a course a student must obtain permission from his dean. Factors to be considered by the dean include health, necessary outside work, and, up to the time midterm grades are issued, course overload. In addition, the instructor of the course from which the student withdraws must certify the student's standing in the course as satisfactory or as failing. In the former case a *WP* will be entered on the permanent record and in the latter a *WF*. Course work discontinued without approval will ordinarily result in a grade of *F*.

Within the School of Engineering and the School of Nursing the signature of the adviser is necessary for dropping or adding courses after classes begin. With the approval of their academic dean, students in engineering and nursing who are carrying a course overload may drop a course without penalty until the time mid-semester grades are assigned. Factors such as poor health or compelling outside commitments are considered in permitting withdrawal from courses without penalty. A *W* is entered on the permanent record in lieu of a grade in all cases when withdrawal without penalty is approved. Courses discontinued at any time without approval or withdrawal from any course after the mid-semester time limit has expired will ordinarily result in a grade of *F*.

Course Load and Eligibility for Courses

The normal and expected course load each semester is 4 semester-courses. To take fewer than 4 or more than 5 semester-courses in any semester, a student must have the approval of his academic dean. No student, however, may take more than 6 courses in any semester. With the approval of their academic adviser, seniors in the School of Nursing who need fewer than 8 courses may take a 3-course load either semester; seniors in Trinity College and the School of Engineering need permission of the appropriate academic dean.

"Self-pacing" during a given calendar year (two regular semesters plus three Duke summer terms) is also possible with the approval of one's academic dean and faculty adviser (and in consultation with the Office of Financial Aid if the student is receiving monetary support from the University). A student may apply for one or more semesters of underload in a given calendar year after his freshman year. In every case, however, a student must meet the minimum requirements for semester to semester continuation at Duke, as well as those that apply at the end of each calendar year. Advanced placement credits and summer work taken elsewhere are excluded when minimum requirements are considered under this plan.

The rules established by the Graduate School provide that juniors and well-qualified sophomores may enroll in a 200-level (senior-graduate) course if they have obtained the written consent of the instructor, as well as that of the director of graduate studies in the department concerned. Undergraduate students are not permitted to enroll in 300-level courses.

Seniors who at the beginning of a semester lack no more than 3 semester-courses for the fulfillment of the requirement for the Bachelor of Arts or Bachelor of Science degree may enroll in graduate courses for a maximum total program of 5 semester-courses. The permission of the Dean of the Graduate School is required.

Course Audit

With the written consent of the instructor, a full-time degree student is allowed to audit one or more courses in addition to the normal program. With the consent of the instructor and the Registrar, alumni may audit undergraduate courses at the usual auditing fee. After the drop/add period in any semester, no student classified as an auditor in a particular course may take the course for credit, and no student taking a course for credit may change classification to an auditor. A student may not repeat for credit any course he has audited. Auditors submit no daily work, take no examinations, and receive no credit for courses.

Independent Study

Independent study enables a student to pursue individual research and reading in a field of special interest subject to the supervision of a member of the faculty. (See page 10.) A student—with approval of his adviser, the instructor, and the director of undergraduate studies of the instructor's department—may enroll in independent study for any semester of his enrollment at Duke.

House Courses

House Courses are initiated and organized by students within given residential units. They are generally, but not necessarily, interdisciplinary in nature. If students are to earn credit for a course, it must be sponsored by a faculty member in the arts and sciences, acted upon by the department of that faculty member, and approved by the Committee on Courses of the Undergraduate Faculty Council of Arts and Sciences. House Courses may carry half-course credit. They do not fulfill distributional requirements, and no more than 2 semester-course credits earned in House Courses may be counted toward the course requirement for graduation. Grades are submitted on a pass-fail basis. The Secretary of the Committee on Courses can provide further details.

Declaration of Major or Division

Each freshman must declare a division of interest (humanities, social sciences, or natural sciences)—or a major if he wishes—by registration in April of the freshman year, and all students must declare a major before mid-February of the sophomore year. When a student declares a major he must also identify his second and third divisions. The form for declaring a major or division is available from academic deans and is also provided to freshmen with registration materials in the spring semester.

An interdepartmental concentration may be declared after the student confers with the directors of undergraduate studies of the departments to be involved, and they or other advisers assist him in preparing a program of course work. The program must consist of at least 3 courses beyond the introductory level in each of the departments. An interdepartmental concentration must be planned early in the undergraduate career. One of the departments should be identified as primarily responsible for the student's advising. A copy of the plan for the program, with a descriptive title which will appear on the student's permanent record, should be presented along with the written approval of the directors of undergraduate studies to the appropriate academic dean. Students who declare interdepartmental con-

centrations must identify the second and third divisions and satisfy those requirements and all others for Program I.

A student may declare a second major to be recorded on his permanent record. A second major should be declared in the office of his academic dean before a student registers for his final semester.

Changes in departmental majors or interdepartmental concentrations must be registered in the office of the student's academic dean.

After a student declares a major he is assigned an adviser in the department of his major and an academic dean in the division of his interest. Freshmen who do not declare a major, but rather a division, are advised by the academic dean in the division.

Class Attendance and Excused Absences

Responsibility for class attendance rests with the individual student. He is expected to attend classes regularly and punctually and must accept the consequences of failure to attend. An instructor is privileged to refer to the student's academic dean a student who in his opinion is absent excessively. Absenses from required classes and tests ordinarily are excused only for illnesses certified by a proper medical official of the University, and for authorized representation of the University in out-of-town events. Officials in charge of groups representing the University are required to submit names of students to be excused to the appropriate dean's office forty-eight hours before absences are to begin.

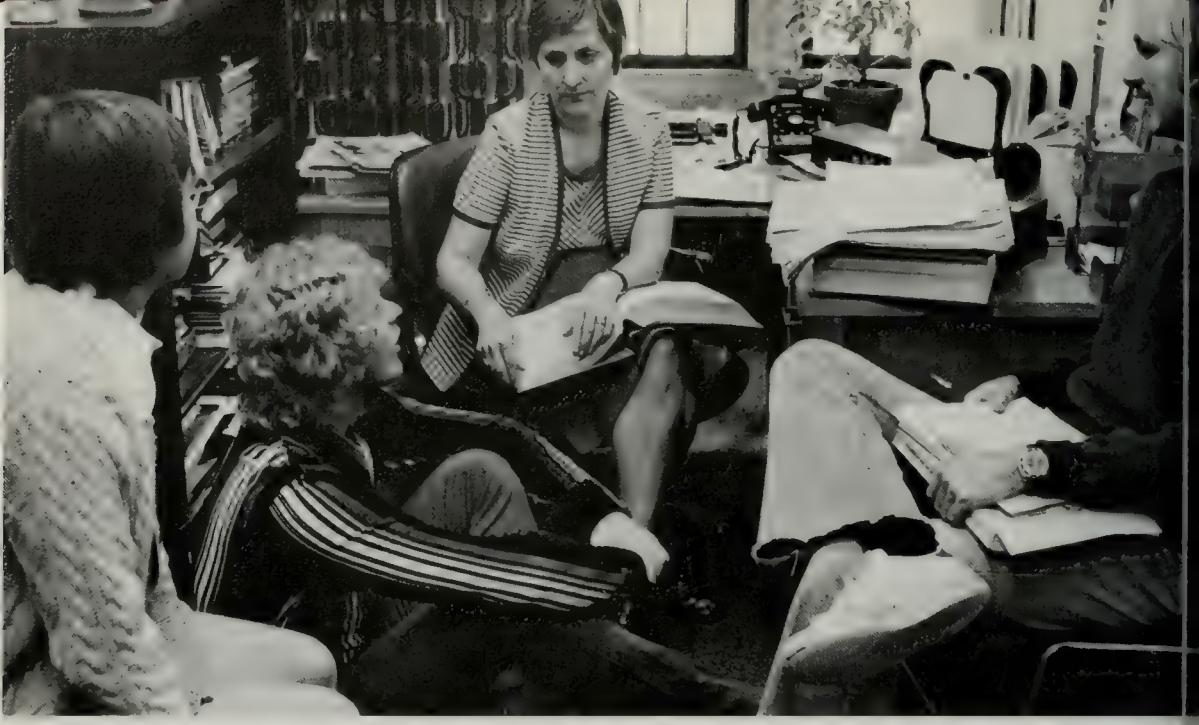
Final Examinations and Excused Absences

Unless departmental policy stipulates otherwise, the conduct of the final exercise is determined by the instructor. However, a final written examination may not exceed three hours in length and a final "take-home" examination may not require more than three hours in the actual writing. "Take-home" examinations are due at the regularly scheduled hour of an examination based on the time period of the class. The times and places of final examinations are officially scheduled by the University Schedule Committee, generally according to the day and hour at which the course regularly meets. No changes may be made in the schedule without the approval of the Committee.

If a student is absent from a final examination, he receives an *X* instead of a final grade. He must present an acceptable explanation for his absence to the appropriate academic dean's office within forty-eight hours after the scheduled time of the examination or the *X* is converted to an *F*. If the absence is excused by a dean, the student arranges with the dean and the instructor for a make-up examination at the earliest possible time. An *X* not cleared by the end of the semester following the examination missed is converted to an *F*.

Grading and Grade Requirements

Final grades on performance in academic work are sent to students and parents, or guardians, after the examinations at the end of the fall semester. At the close of the spring semester, grades are mailed to the student's home address. Mid-semester advisory grade reports for freshmen are issued each semester.



Passing Grades. Passing grades are *A*, exceptional; *B*, superior; *C*, satisfactory; *P*, passing (see pass/fail option below); and *D*, low pass. These grades may be modified by a plus or minus. A *Z* may be assigned for the satisfactory completion of the first semester of a two-course sequence, and the final grade for both courses is assigned at the end of the second course of the sequence.

Although the *D* grade represents *low pass*, no more than two courses passed with *D* grades may be counted among the 32 courses required for graduation. Courses for which a *D* grade is earned, however, satisfy distributional requirements, as well as requirements in the major, English composition, and small-group experiences.

Failing Grades. A grade of *F* or *U* (see pass/fail option below) indicates that the student has failed the course. The grade is recorded on the student's record. If he registers for the course again, a second entry of the course and the new grade earned are made on the record, but the first entry is not removed.

Pass/Fail Grading Option. With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one elective, non-major course each semester or summer term. In addition, with the consent of the instructor, adviser, and director of undergraduate studies, a student may take for pass/fail credit courses in independent study or internship in any department including that of his major. Certain courses are offered only on a pass/fail basis. Unless a course is offered *only on a pass/fail* basis, a course passed under the pass/fail option does not apply to distributional requirements.

After the drop/add period in any semester, no student may change his status to or from a pass/fail basis. A pass grade may not subsequently be converted to a regular letter grade nor may the course be retaken on a regular credit basis.

Grades When Absent from Final Examination. (See Final Examinations and Excused Absences on page 39.)

Grade for Incomplete Work. If because of illness or other emergency a student's work in a course is incomplete, he may receive an *I* for the course instead of a final grade. Incomplete courses must be completed before the close of the succeeding semester; otherwise, the *I* is converted to an *F*. Seniors are expected to complete all courses before graduation. In case a student whose work is incomplete is also absent from the final examination, he receives an *X* for the course. For the purposes of determining if a student satisfies continuation requirements, an *I* is counted as failing to achieve satisfactory performance in that course.

Commencement

Degrees are conferred at commencement exercises in May to those who have completed requirements at the end of either regular semester of the academic year. Those who complete degree requirements at the end of a summer term become eligible to receive diplomas dated September 1, but no commencement exercises are held for such graduates, and the diplomas are mailed in December, after final approval by the Academic Council and Trustees.

Academic Honors

To determine eligibility for academic honors, only grades earned at Duke enter into the calculation of the average.

Dean's List. In recognition of superior academic achievement, freshmen, sophomores, and juniors who carry a normal academic load and earn a *B* average or higher in the two semesters of an academic year are placed on the Dean's List if the following additional requirements are met:

1. Grades other than *P* have been earned in 6 semester-courses.
2. No incomplete or failing grade has been received within the academic year.

Class Honors. Students in the freshman, sophomore, and junior year who carry a normal academic load and earn a *B+* average on all work for the year are eligible for Class Honors provided the following conditions are also met:

1. Grades other than *P* have been earned in 6 semester-courses.
2. No incomplete or failing grade has been received within the academic year.

Graduation Honors. Students who earn the following averages for all work taken at Duke are graduated with honors: *B* average, *cum laude*; *B+* average, *magna cum laude*; and *A-* or above, *summa cum laude*.

Graduation With Distinction. Most of the academic departments offer programs for Graduation with Distinction for students in Programs I and II and in all engineering programs. To be eligible, students must show promise of achieving by the time of graduation at least a *B* average in the major field. Departments or interdepartmental honors committees may invite a student at the end of the sophomore or junior year to enter the Graduation with Distinction Program. After participation in a seminar in the junior or senior year, and/or a directed course of reading, laboratory research, or other independent study, the student must present the results of his individual research and study in a distinguished piece of writing. The student's achievement, including the paper, is assessed by a faculty committee, and if the student has at least a *B* average in the major field, the committee may recommend that the student be graduated

with distinction in his major field. A student engaged in an interdisciplinary program must attain an overall *B* average for his courses taken in the departmental areas of his concentration or special study; his achievement is assessed by an interdepartmental honors committee established by the directors of undergraduate studies in the departments concerned. An interested student should consult the director of undergraduate studies in his department.

Other Honors. Election to the freshman honorary societies, Ivy and Phi Eta Sigma, of students who earn a *B+* average is made at the end of the first semester and also at the end of the freshman year. The requirements are the same as those for class honors.

Elections to the national honorary society Phi Beta Kappa are held in the fall and spring; seniors are elected at both times, juniors in the spring only. Additional elections, chiefly of transfer students and doctoral students, are held in the fall following the students' graduation or the award of the Ph.D. Eligibility for election is determined not by the University but by the local chapter of the Society. Eligibility is based on good character and superior academic achievement. Seniors are normally considered upon the completion of six or seven semesters of work (or the equivalent), to no less than four-fifths of which letter grades have been awarded at Duke. Juniors are considered upon the completion of five semesters of exceptionally meritorious work. The total number elected usually does not exceed 8 percent of the graduating class. Inquiries may be directed to the Secretary of Phi Beta Kappa, Box 4795 Duke Station, Durham, North Carolina 27706.

Several prestigious fellowships for graduate study are open to applicants from Duke University. Students are selected competitively. Any student interested in these opportunities should consult the academic dean in charge of fellowships.

Prizes and Awards

The achievements of undergraduate students are recognized in various fields of college activity. The following prizes suggest the range of the recognition.

The Robert E. Lee Prize. This prize is the gift of the late Reverend A.W. Plyler, of the Class of 1892, and Mrs. Plyler. The sum of $50 is awarded annually at Commencement to the man in the senior class of Trinity College of Arts and Sciences or the School of Engineering who, in character and conduct, scholarship, athletic achievement, and a capacity for leadership, has most nearly realized the standards of the ideal student.

Julia Dale Prize in Mathematics. This is an annual cash prize of at least $50. The winner is selected by the Department of Mathematics on the basis of excellence in mathematics. In some years first and second prizes are given.

The Henry Schuman Music Prize. This prize of $100 is awarded annually to an undergraduate of Duke University for an original composition of chamber music or a distinguished paper in music history or analysis. The award is sponsored by Trinity College of Arts and Sciences and the Department of Music at Duke University through a continuing gift from Dr. and Mrs. James H. Semans who named the prize after Mr. Henry Schuman, a life-long friend of the Semans and Trent families, a talented amateur violinist, and one who helped to build valued collections in the Duke Library.

The Phi Lambda Upsilon Prize. Phi Lambda Upsilon, honorary chemical

society, yearly awards a suitable prize to an outstanding junior who is majoring in chemistry. The recipient's name is inscribed on a plaque displayed in the Chemistry Library.

The Chemistry Department Award. This prize recognizes outstanding scholarship in chemistry and is awarded at graduation to the B.S. major in chemistry with the best academic record in his class. The prize is a one-year subscription to the *Journal of Chemical Education*. In case of a tie, equal awards are given.

The James B. Rast Memorial Award in Comparative Anatomy. This award is given annually by the parents of James Brailsford Rast in memory of their son, a member of the class of 1958 at Duke University. The award, consisting of the *Atlas of Descriptive Human Anatomy* by Sobotta and bearing the James B. Rast Memorial bookplate, is given to the student who demonstrates the greatest achievement in the study of comparative anatomy.

A. J. Fletcher Scholarships. These Music Department scholarships are given to students who can demonstrate, by tape or audition, talent and achievement in instrumental or vocal performance. These awards range between $500 and $1,200 per annum, depending on need, and are renewable yearly for up to four years. Although recipients are not required to major in music, they are expected to study privately and to participate in departmental performing groups.

The Winfred Quinton Holton Prize in Primary Education. This prize was established in 1922 by gifts of Holland Holton, '07, and Mrs. Lela Young Holton, '07, in memory of their son, Winfred Quinton Holton, with the income to be used to provide a prize for investigative work in primary education. This prize of approximately $175 may be made annually. Competition is open to Duke seniors and graduate students who are candidates for a degree in elementary education. A student who wishes to be considered for the prize must submit a paper to be judged by a faculty committee in the Department of Education. The student must first secure a faculty supervisor, and only scholarly papers which the student and faculty supervisor deem appropriate for publication should be submitted. Papers must be submitted by April 1 for consideration in a particular year.

The Anne Flexner Memorial Award in Creative Writing. This award has been established by the family and friends of Anne Flexner, who graduated from Duke in 1945. It consists of $200 (first prize), $100 (second prize), and $50 (third prize). The awards are given annually for the best pieces of creative writing submitted by Duke undergraduates. The competition is limited to short stories (7,500-word limit), one-act plays (7,500-word limit), poetry (200-line limit), and informal essays (5,000-word limit). Only one manuscript may be submitted by a candidate, and it must be delivered to the Department of English, Room 325 Allen Building, by March 15.

The Ann Barbour Stow Memorial Award. This award has been established by the family and friends of Ann Barbour (Stow), who graduated from Duke in 1963, with a major in English. The stipend, approximately $500, is awarded, usually during the senior year, to an undergraduate English major, who best fulfills those qualities which the late Mrs. Stow represented.

The David Taggart Clark Prize in Classical Studies. This prize is awarded to the senior major in Greek, Latin, or Classical Studies who is judged to have written the best honors essay of the year.

The William Senhauser Prize. Given by the mother of William Senhauser in memory of her son, a member of the Class of 1942, who lost his life in the Pacific Theater of War on August 4, 1944, this award is made annually to the student in Trinity College of Arts and Sciences or the School of Engineering who has made the greatest contribution through participation and leadership in intramural sports. The winner of this prize is chosen by a committee appointed by the President of the University.

The Roger Alan Opel Memorial Scholarship. A grant of $500 or more is awarded annually to a Duke student who will spend an undergraduate year of academic study at the University of Exeter, England. The student is selected on the basis of intellectual curiosity, academic ability, and financial need. The award was established by the parents of Roger Alan Opel, a senior at Duke University who was killed in November, 1971.

The William T. Laprade Prize in History. This prize is offered in honor of William T. Laprade, who was a member of the Department of History at Trinity College and Duke University from 1909 to 1953, and Chairman of the Department from 1938 to 1952. It is awarded to that senior who is graduating with distinction and whose senior essay in history has been judged unusually meritorious.

The Edward C. Horn Memorial Prize for Excellence in Zoology. This prize is given each year to the graduating zoology major who, in the opinion of the zoology faculty, shows the highest level of academic achievement and promise. It is offered in memory of Professor Edward C. Horn as a tribute to his warm regard for students and faculty and his appreciation of scholarly excellence. The prize consists of books appropriate to the student's field of interest.

The James A. Oliver Memorial Award. This award was established in 1963 by the family of James A. Oliver and is given to the student or students who have done the most to further the interest of music at Duke University. A prize of up to $150 is awarded annually.

The Tau Beta Pi Prize. This prize is awarded each year by North Carolina Gamma Chapter of Tau Beta Pi, engineering national honor society, to a sophomore student in engineering for outstanding scholastic achievement during the freshman year.

The Walter J. Seeley Scholastic Award. This award is presented annually by the Engineers' Student Government to that member of the graduating class of the School who has achieved the highest scholastic average in all subjects, and who has shown diligence in pursuit of an engineering education. The award was initiated to honor the spirit of academic excellence and professional diligence demonstrated by Dean Emeritus Walter J. Seeley. It is hoped that this award will serve as a symbol of the man and the ideals for which he stands. The name of the recipient is inscribed on a plaque displayed in the Engineering Building.

The American Society of Civil Engineers Prize. The prize is awarded annually by the North Carolina Chapter of the American Society of Civil Engineers to two outstanding seniors of civil engineering, upon recommendation of the faculty of the Civil Engineering Department. The basis for selection is the student's scholastic record, his contribution to the student chapter, and his participation in other college activities and organizations. The prize consists of a Certificate of Award and the payment of one year's dues in the American Society of Civil Engineers.

The American Public Works Association Prize. This prize is awarded annually by the North Carolina section to an outstanding senior in civil engineering upon the recommendation of the faculty of the Civil Engineering Department. The basis for selection is the student's scholastic record and his interest in a career in public works. The prize consists of a Certificate of Award, one year's payment of dues in the American Public Works Association, and a $25 cash award.

The George Sherrerd III Memorial Award in Electrical Engineering. This award is presented annually to that senior student in electrical engineering who, in the opinion of the electrical engineering faculty, has attained the highest level of scholastic achievement in all subjects and simultaneously has rendered significant service to the School of Engineering and the University at large. The award was established in 1958 by the parents of George Sherrerd III, a graduate of the Class of 1955, to recognize outstanding undergraduate scholarship. The recipient receives a monetary award and his name is inscribed on a plaque displayed in the Engineering Building.

The Charles Ernest Seager Memorial Award. This award recognizes outstanding achievement in the annual Student Prize Paper Contest of the Duke branch of the Institute of Electrical and Electronics Engineers. The award, established in 1958 by the widow and friends of Charles Ernest Seager, a graduate of the Class of 1955, consists of inscribing the name of the contest winner on a plaque displayed in the Engineering Building.

The Milmow Prize. This prize is awarded annually to the student from North or South Carolina graduating in the Department of Electrical Engineering, who, in the opinion of the faculty of that department and, as shown by his grades, has made the most progress in electrical engineering during his last year in school. The prize consists of a Certificate of Award and one year's payment of dues in the Institute of Electrical and Electronics Engineers for the membership year in which the honoree is awarded his baccalaureate degree.

The Raymond C. Gaugler Award in Materials Science and Engineering. This award is presented annually to the senior who has made the most progress at Duke in developing competence in materials science or materials engineering. The basis for selection is the student's scholastic record, research or design projects completed at Duke, and interest in a materials-related career. The award has been established by Patricia S. Pearsall in memory of her grandfather, Mr. Raymond C. Gaugler, who was President of the American Cyanamid Company prior to his death in 1952.

The American Society of Mechanical Engineers Award. This award is presented annually to a senior in mechanical engineering for his outstanding efforts and accomplishments in behalf of the American Society of Mechanical Engineers Student Section at Duke. The award consists of a Certificate of Recognition.

The T. C. Heyward Award. This award is given annually to the outstanding sophomore in mechanical engineering by Pi Tau Sigma. The award will normally consist of a handbook as well as a small cash award.

Duke University School of Nursing Alumnae Award. The Duke University School of Nursing Alumnae Award is presented to the student in the graduating class who has demonstrated outstanding leadership, scholarship, and nursing skill.

The Moseley Award. The Moseley Award of $25 is given to the student

in the senior class who has shown the most skill in the art of nursing throughout her program in the School of Nursing.

Outstanding Service Award. The Outstanding Service Award is presented to the student who has demonstrated outstanding service to the School of Nursing or community by having consistently shared knowledge and ability either as a member of a group or a leader of a group for the educational or cultural improvement and welfare of others.

Enrollment for the Duke Summer Session

Undergraduates of Duke University who plan to attend one or more terms of a Duke summer session or who plan to take a course in independent study during the summer should register, if possible, in the spring at the same time they register for the fall semester. Enrollment after the spring registration period may be initiated in the office of the appropriate academic dean. Undergraduates in universities or colleges outside of Duke University should apply directly to the Director of the Summer Session, Duke University, Durham, North Carolina 27706.

Distinctive features of summer session instruction are provided in the various conferences sponsored by several of the departments and by a program in marine biology offered at the Duke Marine Laboratory, Beaufort, North Carolina. See *Bulletin of the Summer Session.*

Changes in Status

Withdrawal and Readmission. A student who wishes to withdraw from college must give official notification to his academic dean. For a student who withdraws on his own initiative prior to the Thanksgiving recess in the fall semester or prior to April 15 in the spring semester, a *W* is assigned in lieu of a regular grade for each course. After these dates an *F* grade is recorded unless withdrawal is caused by an emergency beyond the control of the student.

Applications for readmission are made to the appropriate school or college. Each application is reviewed by officers of the school or college to which the student applies and a decision is made on the basis of the applicant's previous record at Duke, evidence of his increasing maturity and discipline, and the degree of success attendant upon his activities during the time away from Duke. Students who are readmitted usually cannot be housed on campus.

Applications for readmission must be completed by November 15 for enrollment in January, by April 1 for enrollment in the summer, and by July 1 for enrollment in September. For readmission to the School of Nursing, however, it is required that the readmission procedure be completed by March 1 for September enrollment and by November 1 for January enrollment.

Leave of Absence. An upperclass student in good standing may apply to his academic dean to take a leave of absence for one or two semesters. He must apply before December 1 for a leave of absence during the spring semester, and before July 15 for a leave of absence during the fall semester. Additional information is available from the academic deans. If granted leave, the student must keep his dean informed of any change of address.

Registration materials are mailed to all students on leave of absence. A student failing to register will be withdrawn from the University and will have to apply for readmission.

A student who undertakes independent study under Duke supervision and for Duke credit is *not* on leave of absence even if he studies elsewhere. He registers at Duke as a non-resident student and he pays the appropriate fees or tuition at Duke. This also applies to Duke programs conducted away from the Durham campus.

Transfer Between Duke Schools and the College. A student in good standing may be considered for transfer from one Duke undergraduate school or college to another upon written application and request for letter of recommendation from his academic dean. The review of a student's request to transfer will involve consideration of his general academic standing, citizenship record, and relative standing among the group of students applying for transfer. The school or college to which transfer is sought will give academic counseling to a student as soon as his intention to apply for transfer is known, although no commitment will be implied in doing so. Students wishing to transfer to the School of Nursing for the succeeding year must complete transfer proceedings by March 1; however, openings for transfer are limited. Students seeking transfer are advised to consult the Director of Academic Programs in Nursing as early as possible.

A student may apply to transfer at any time prior to the awarding of a baccalaureate degree or after. If admitted after having earned a baccalaureate degree, he must undertake prescribed additional undergraduate work to qualify for a second baccalaureate degree.

Full-Time and Part-Time Degree Status. Ordinarily candidates for degrees are expected to enroll for a normal course load each semester. A student who needs to change from full-time status, however, or from part-time to full-time status, must consult his academic dean. For special reasons approved by the dean, a full-time student who is qualified to continue may register as a part-time student for no more than two courses. Part-time students may not live in the residence halls.

Resident and Non-Resident Status. Sophomores, juniors, and seniors who wish to live off-campus may apply to the Dean of Students or the Dean of Student Affairs of the School of Nursing as appropriate. (See page 58.)

Nondegree to Degree Status. A nondegree student must apply to the Office of Undergraduate Admissions for admission to degree candidacy.

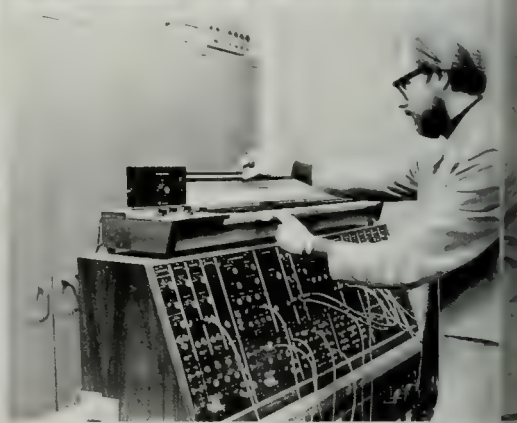
Study Elsewhere

Concurrent Enrollment. A student enrolled at Duke may not concurrently enroll in any other school or college without special permission of the appropriate academic dean. See, however, the statement regarding the reciprocal agreement with the University of North Carolina at Chapel Hill, North Carolina Central University at Durham, and North Carolina State University at Raleigh.

Summer Schools. Approval forms for courses to be taken at institutions other than Duke may be obtained from the offices of the academic deans. A student wishing to transfer credit for proposed summer work at another accredited college should present a summer catalog of that institution to his dean and to the director of undergraduate studies in each discipline in which he proposes to take a summer course and obtain their approval prior to taking the courses.







Study Abroad. A Duke student may earn up to 8 course credits during an academic year for approved work completed at a foreign university or for an approved program abroad sponsored by Duke or by another American college or university. To earn the equivalent of 4 Duke credits each semester, the student who studies abroad will be expected to take a full course load as defined by the program or institution in which he is enrolled. Usually work to be considered for transfer credit must be done in the language in which courses are normally given at the institution attended. Duke, at present, offers several programs in cooperation with other universities. Grades earned in these programs are recorded on the student's official Duke record. Students accepted may study at:

Aix-en-Provence, France. Courses are given in French language, art, philosophy, and literature. Completion of French 74, or equivalent, is required prior to departure. This program is administered through Vanderbilt University.

Madrid, Spain. Work is given in Spanish language, literature, art, music, and history for either the fall or spring. Completion of Spanish 74, or equivalent, is required prior to departure. This program is under the direct administration of Vanderbilt University.

Rome, Italy. As one of the participating members in the Intercollegiate Center for Classical Studies in Rome, Duke University nominates majors in classical studies for admission to a semester's work at the center, usually in

the junior year. Instruction is offered in Greek, Latin, ancient history, ancient art, and archeology. Some scholarship help is available.

Munich and Freiburg, Germany. Admission to these programs entails matriculation at the University of Munich or Freiburg. The student must, therefore, meet their admission standards. Courses are taken in German language, literature, art, and history through Wayne State University, while additional courses are taken at the German universities.

Warwick, England. In the Warwick Exchange Program, selected Duke students spend a year of study at the University of Warwick, while students from Warwick study for the same period at Duke. The program is designed especially for majors in English, and it is administered jointly by Duke and the University of Warwick.

Leaves of absence from the University are granted to students who study abroad. When possible, arrangements are made for them to register while abroad for the semester in which they plan to return.

Duke University sponsors from time to time summer programs in Austria, France, Germany, Israel, Italy, and Spain. Students are selected competitively and have an opportunity to earn credit and grades for 2 courses.

A student who wishes to transfer credit for study abroad should be guided by the following provisions established by the faculty and administered by the Committee on Study Abroad.

The student should:

1. have a scholastic average of at least a $B-$;
2. obtain provisional approval to study abroad from the adviser on study abroad and the director of undergraduate studies in his major department;
3. receive certification, when applicable, from the foreign language department concerned, that he has adequate knowledge of the language of the country where he will study;
4. obtain, *before* leaving Duke, approval for each course to be taken abroad, by the appropriate director of undergraduate studies, as well as approval of the program by the adviser on study abroad;
5. apply for leave of absence once program plans are complete.

Information and counsel regarding study abroad may be obtained from the adviser on study abroad; in all cases he must be informed in advance about a student's plans if credit for the work is desired.

Other Information

Release of Student Records. No information contained in student records (academic or otherwise) is released without the written consent of the student. Authorization forms are available in the offices of the academic deans.

Identification Cards. Undergraduate students are issued identification cards and semester enrollment cards which they should carry at all times. These cards are the means of identification for library privileges, University health services, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee. The cards are not transferable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of a card immediately to the Registrar's Office. The cost of a new identification card is $5.



Cooperative Programs

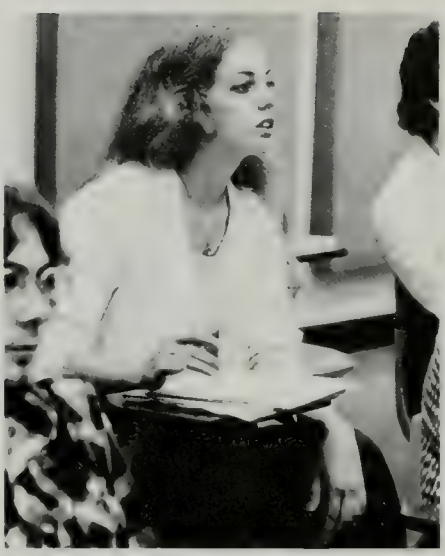


Reciprocal Agreements with Neighboring Universities

Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina State University at Raleigh, and North Carolina Central University at Durham, a student regularly enrolled in Duke University, and paying full fees, may enroll for one approved course per semester at one of the institutions in the cooperative program. If the student takes 2 or more courses during a summer at Duke, one of the courses may be taken at one of the neighboring institutions under this plan.

Approval forms for courses to be taken at neighboring institutions may be obtained from the offices of the academic deans at Duke. Ordinarily, only those courses not offered at Duke will be approved. The student pays any special fees required of students at the host institution, and he must provide his own transportation.

Judaic Studies at Duke University and the University of North Carolina at Chapel Hill. Established in 1973 and supported by Duke University and the University of North Carolina-Chapel Hill, the Cooperative Program in Judaic Studies provides the opportunity of studying Jewish civilization through a broad range of courses including Hebrew language and literature, Yiddish language and literature, the archaeology of Palestine, and the history of Jewish religious thought. The program is administered by a Joint Planning Council which also sponsors visiting speakers and professorships, library acquisitions, exchange programs with Israeli universities, summer school programs in Israel, and a publication program.







The Cooperative Program in Judaic Studies provides study in the languages, literature, archaeology, history, and religion of Jewish civilization from Biblical to modern times. Students seeking further information on the program in Judaic Studies should consult Dr. Eric Meyers or Dr. Kalman Bland in 230 Gray Building.

Continuing Education

Residents in the Durham community who are beyond college age but have interest in resuming or beginning an undergraduate education are invited to the Center for Career Development and Continuing Education for preliminary

counseling. If admitted to the program in continuing education, such students may apply for degree candidacy after the satisfactory completion of 4 courses. A guidance seminar for women, *New Directions*, is offered each semester for adult women who wish to explore their potential and evaluate community opportunities for education, employment, and non-paid involvement. Conversations in continuing education, which is a series of informal discussions on issues of concern to the returning student, are held throughout the year. Each semester a program of non-credit courses for area residents is sponsored by the center. Conferences and workshops on a variety of topics are also held throughout the year. For further information consult the Director, Center for Career Development and Continuing Education.

Reserve Officer Training Corps

Through the Naval and Air Force Reserve Officer Training Programs, the University is cooperating with the Department of Defense in providing well-educated officers for the regular and reserve forces of the nation.

The Naval Reserve Officer Training Corps. Two basic programs through which students can qualify for Naval commissions upon graduation are offered. One, the Scholarship Naval Reserve Officer Training Corps Program provides a maximum of four years of university study largely at government expense, followed by a commission in the regular Navy or Marine Corps. The other, the College Program, leads to a commission in the Naval Reserve or Marine Corps Reserve.

The Scholarship Program. Quotas are awarded on the basis of an annual nationwide test and selection procedure. Students selected are enlisted in the Naval Reserve, appointed Midshipmen, USNR, and receive four years tuition, fees, and textbooks at government expense. In addition, they receive subsistence pay and summer active duty pay which amounts to approximately $1,300 per year. Students in the NROTC Scholarship Program are encouraged to pursue majors in engineering (civil, electrical, or mechanical) or in specific science fields (mathematics, chemistry, physics, or computer science). Other fields of study leading to a first baccalaureate degree are permitted with the approval of the Professor of Naval Science. Students participate in two summer training cruises aboard ship and receive aviation and amphibious indoctrination at naval shore stations for one summer.

Upon graduation, the student receives a commission as Ensign in the Regular Navy, or Second Lieutenant in the Regular Marine Corps, after which he serves with the Navy or Marine Corps as required by the Secretary of the Navy in the same manner as graduates of the Naval Academy. The minimum period of active duty is four years for regular officers.

The College Program. The College Program student is selected from regularly enrolled freshmen in Duke University who desire to qualify for a commission in the Naval or Marine Corps Reserve while pursuing normal courses of study. Upon graduation, he will normally be ordered to three years of active duty. He has the status of a civilian who has entered into a mutual contract with the Navy, and he is not eligible for the benefits and pay received by Scholarship Program Midshipmen. He enlists in a component of the Naval Reserve and receives subsistence pay of $100 a month during his last two academic years. In addition, he receives active duty pay (about $300) during the one required summer cruise. This cruise normally occurs during the summer between the student's junior and senior years.

Scholarship and College Program Students. No distinction is made between students in the two programs in the NROTC Unit. College Program students may compete each year for the Scholarship Program. If selected, they will be appointed to Scholarship status with the attendant benefits and pay. Students in both programs are provided necessary uniforms, equipment, and Naval Science textbooks; both are furnished the same instruction, and both are required to wear uniforms on drill days and upon special occasions prescribed by the Professor of Naval Science. Upon completion of their undergraduate work, both may apply for continuing studies leading to a graduate degree. If he desires, a student in either program may elect the Marine Corps option at the beginning of his junior year, thus qualifying for a commission in the Marine Corps. Both may participate in a Navy sponsored Flight Instruction Program leading to qualification for a private pilot's license upon successful completion of the program.

Academic Requirements for a Commission. The academic program for an approved degree and a commission for Scholarship and College Program students must include all Naval Science courses offered and the following:

For NROTC Scholarship students, one year of calculus, one year of physics, and Computer Science 51 (or equivalent) are to be completed by the end of the junior year. History 149, Management Science 125, and Political Science 121, 122, or 158 are to be completed prior to graduation.

For NROTC College Program students, courses are not required in calculus, physics, or computer science, but students are strongly recommended to complete these courses in view of their career value, military or otherwise. Completion of these courses will receive consideration in the awarding of scholarships by the Professor of Naval Science. History 149, Management Sciences 125, and Political Science 121, 122, or 158 are to be completed prior to graduation. Marine option students in their junior and senior years will take two relevant courses, approved by the Professor of Naval Science and taught by University faculty members.

The Air Force Reserve Officers Training Corps (AFROTC). This unit functions as the Department of Aerospace Studies. It selects, trains, and commissions college men and women who desire to serve in the United States Air Force. Two AFROTC programs exist, a four-year and a two-year program.

The four-year program consists of two segments, one covering the freshman and sophomore years which includes General Military courses, and the other covering the junior and senior years which includes Professional Officer courses. These two segments are linked by a four-week summer field training encampment at selected Air Force bases. Entry into the four-year program is open to freshmen and to sophomores who are willing to make up the course work missed due to late entry into the program. For sophomores this amounts to taking both the freshmen and sophomore courses in one year.

Applications for the two-year program should be submitted no later than the spring semester of the sophomore year. Candidates attend a six-week field-training encampment following their sophomore year, which concentrates on the course work missed during the freshman and sophomore years.

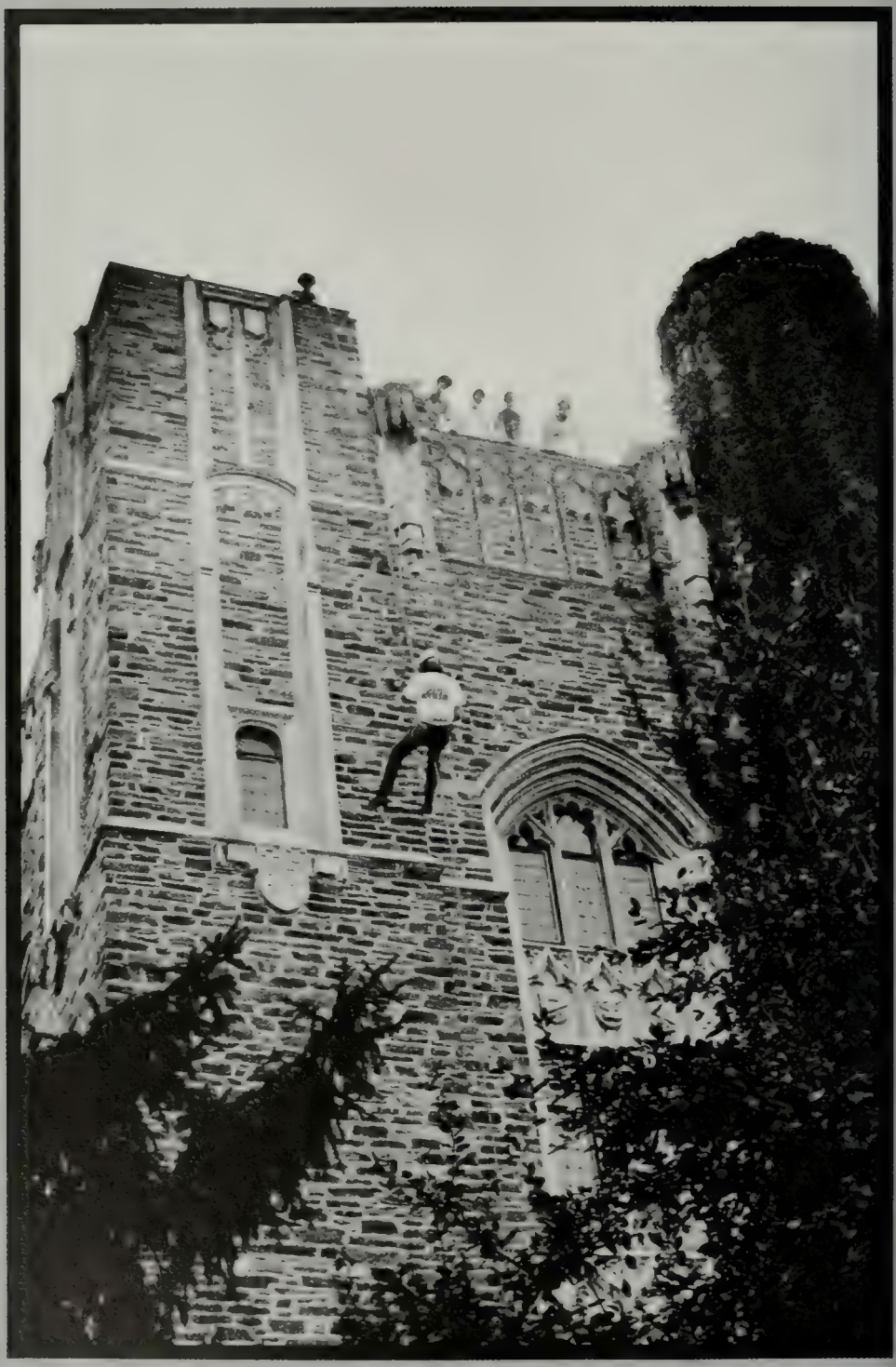
Cadets may compete for a scholarship if they so desire: freshmen for a three-year scholarship to begin with the sophomore year; sophomores for a two-year scholarship to begin with the junior year. Candidates for the two-year program may compete for a scholarship during the six-week summer encampment. Scholarships cover full tuition, cost of all required books, certain fees, as well as a stipend of $100 per month. Regardless of scholarships, all

cadets receive a tax free stipend of $100 per month (limited to $2,000) during their junior and senior years.

A four-year active service plus two-year reserve commitment is incurred upon entry into the Professional Officer segment of the AFROTC Program. For details on entry and commissioning requirements, contact the office of Aerospace Studies.

Army and Navy Nurse Corps Student Program. Students in the School of Nursing may apply for appointments in the Army Student Nurse Program at the beginning of their junior year, or in the Navy Nurse Corps Candidate Program at the beginning of their senior year. The appointments carry a generous financial allowance. A student who participates for twelve months or less serves on active duty in the respective service for twenty-four months. If support for two years has been given, thirty-six months of active duty are required.





Student Life



Residential Facilities

It is the aim of the University to provide through its residential program convenient and comfortable lodging that features opportunities for informal learning and the enrichment of the total educational experience. The living units are designed to foster an intellectual atmosphere, to stimulate interest in cultural and cocurricular activities, and to provide opportunities for interaction with faculty, staff, and students from other parts of the country. To assist in the implementation of responsible house government and activities, a member of the residential staff lives in most of the houses.

Freshman students are required to live in University residences unless they live with parents or close relatives. Housing on campus, however, is not available to transfer students, to former students who have been readmitted, or to part-time students.

Residences for Undergraduate Students. Many students in Trinity College of Arts and Sciences and in the School of Engineering live in residences located on both the East and West Campuses. Some residences are reserved for all women's groups comprised of members of all four classes, others for all men's groups comprised of members of all four classes. There are also fraternities located in campus residences.

In some houses men and women are assigned to separate wings or floors of the same house. Another option exists in living-learning houses or corridors where students who qualify by application are brought together because of special interests. The living-learning situations generally are filled by upperclassmen. Still another option is furnished apartments located between campuses.

Many residential units are members of federations. A federation is a cluster of separate residences, usually including two houses for men and two houses for women, joined together under a faculty fellow and federation government for common academic and social programs.

There are also all freshman men's houses on West Campus which accommodate approximately one-half of the freshman men. Each of these houses elects its own officers and council and organizes social, intramural, and other programs. After the freshman year students who do not affiliate with a social fraternity may choose from among the seventeen independent houses.

Nursing students live in Hanes House and Hanes Annex. Entering students may request a double or a single room but returning students have first choice of rooms. After the initial assignment, students arrange for room selection and roommates through the Office of the Dean of Student Affairs in Nursing. Resident house counselors who are on the staff of the Dean of Student Affairs live in the dormitories and are responsible, with the cooperation of the student government, for the administration of the residential units.

Living Off-Campus. Students above the freshman level who wish to live off-campus should apply for such authorization from the appropriate dean of student affairs. Once nonresident status is approved no guarantee can be made of a space in the dormitories should the student desire to move back on campus. Students beyond the normal fourth year of the undergraduate program cannot be guaranteed space in the dormitories.

If a resident student marries while enrolled and plans to move off-campus, a written request for a change to nonresidency must be submitted with the statement of marriage to the Dean of Student Affairs. (In the School of Nursing, a letter from the parents or guardian to the Dean indicating knowledge of the forthcoming marriage must be received prior to the marriage.)

Dining Facilities

The East Campus. All students residing on the East Campus and freshmen in the Graduate Center are required to contract for their meals in the University Dining Halls on a semester basis. They have the option of a seven-day, twenty-one meals a week plan, or a five-day (Monday-Friday) fifteen meals plan. (See Chapter on Financial Information.) There are no provisions for changing plans during the semester. On the East Campus there are two dining halls; ordinarily, the students who reside in Southgate and Gilbert-Addoms take their meals in Gilbert-Addoms, and those living in the other East Campus dormitories take their meals in the East Campus Union. Due to the large number of students served by the dining halls, it is not possible to provide special diets.

The West Campus and Graduate Center. The dining facilities on West Campus include two cafeterias with multiple-choice menus, the Oak Room which is a service dining hall where full meals and *a la carte* items are served, and a self-service snack bar, the Cambridge Inn, which is open throughout the day and evening. The Graduate Center has a public cafeteria and a Coffee Lounge, which is open until 12:00 midnight.

Freshmen and sophomores in the School of Nursing are required to contract for their meals in the University Dining Halls on a semester basis. Their options are the same as those offered to students residing on the East Campus.

Religious Life

Two symbols indicate the importance of the religious dimension for Duke University: *Eruditio et Religio,* the motto emblazoned on the seal of the University, and the location of the Duke Chapel at the center of the campus. Persons from all segments of the University and the surrounding community come together in Duke Chapel on Sunday morning to worship in a service which offers excellence in liturgy, music, and preaching. The University ministers work with the chaplains from the Roman Catholic, Protestant, and Jewish com-

munities to provide a ministry which is responsive to the plurality of University religious interests. The traditional modes of ministry—pastoral, priestly, and prophetic inquiry—are offered in traditional and contemporary forms.

A student can find opportunity within the University community to search for meaning, to ask the ultimate questions, to worship in small communities, to meditate, to participate in contemporary liturgies, to learn from outstanding thinkers in the religious traditions, and to work to bring about a more just and humane society.

Services Available

Offices in Each College and School. In Trinity College of Arts and Sciences, in the School of Engineering, and in the School of Nursing, deans, faculty members, and counselors are readily available to discuss various concerns with students and to assist them in matters relating to courses, majors, careers, co-curricular activities, life styles, residential matters, etc. Often, a dean or counselor within the college or school, or an assigned faculty adviser can help to actualize a plan in the mind of a student, if not directly, by referral. Each college and school has its own academic deans and advisers. In Trinity College of Arts and Sciences, there are academic deans for freshmen as well as academic deans for upperclassmen according to the student's declared major or academic division. In the School of Nursing, each student is assigned an academic adviser for the freshman and each succeeding year.

The School of Nursing has its own Dean of Student Affairs, whereas the Office of the Dean of Student Affairs appertains to students in both Trinity College of Arts and Sciences as well as the School of Engineering. The Office of Black Affairs pertains to the needs of all black students at Duke.

Student Health Service. The aim of the Student Health Service is to provide medical care and health advice to students. Both the Student Health Services Clinic and the University Infirmary are available to students for that purpose.

The facilities of the Student Health Services Clinic are open during both regular and summer sessions to all currently enrolled full-time undergraduate students as well as to regularly enrolled students in the graduate and professional schools. For treatment of illnesses or injuries, students should first visit the Student Health Clinic. The campus bus makes regular runs to the clinic, and emergency transportation can be obtained from either the Duke Campus Police or the Durham Ambulance Service. Residential staff personnel should be consulted whenever possible for assistance in obtaining emergency treatment. For a description of the specific services provided by the clinic and infirmary, see the *Bulletin of Information and Regulations.*

In addition to the Student Health Service, the University provides for a plan of Accident and Sickness Insurance to cover all full-time students who are enrolled in the University. This plan is designed to complement services normally not available to students through the Student Health Service coverage and covers students both on and off campus, at home, or while traveling between home and school during the interim vacation periods throughout the one year of the policy.

The University Counseling Center. The University Counseling Center provides services designed to assist individuals in gaining a better understanding of themselves and of the opportunities available to them and to aid them in developing more effective problem-solving skills. The professional counselors

do not attempt to impose solutions on the individual, but to provide help the individual needs to make judicious decisions to work out his own problems. The following are some of the areas in which counseling services are offered: choosing a career, planning programs leading to careers, identifying and overcoming educational deficiencies, developing greater self-understanding, and developing more effective social relationships.

The counseling center has available a wide variety of tests which may be employed in the counseling process. These tests provide measurements of general ability, scholastic aptitude, special skills, vocational interests, and levels of adjustment. In the process of counseling, the counselee may, with the help of the counselor, choose those tests that may provide information he needs to make decisions. Counseling is confidential between the counselor and student.

The Office of Black Affairs. Through contact with students and participation on administrative staffs and committees within the university, the Office of Black Affairs seeks to create and maintain an atmosphere that is congenial to black students. The focus of the office is upon the student. Counsel and advice is given for academic matters, social concerns, and personal problems. A large percentage of the time is spent interpreting the nature of the environment, and student reactions to it, in an attempt to allay anxieties and undo frustrations that, when left unattended, lead to academic difficulties.

For the educational experience to be successful for black students, provisions must be made for them to interrelate the way of life that nurtured them prior to their coming to Duke with the experience they have and the expectations they will develop while here. To this end, the office helps students interact with the larger community through attending local churches and participating in various social and political activities in the community. The office also coordinates social, religious, and cultural activities on campus, such as the Gospel Choir, and the Dance Group.

Center for Career Development and Continuing Education. The Center provides undergraduate and continuing education students with assistance in establishing career goals. Working in cooperation with the University Counseling Center, the Office of Placement Services, and the deans in the undergraduate college and the professional schools, the center sponsors programs which allow students to preview the situations they are likely to encounter after graduation. These include the Apprenticeship Program, which arranges volunteer placement in community businesses and agencies; the Continuing Education Program which uses student teachers, tutors, and assistants in meeting community needs; and conferences on topics of contemporary concerns. Although the center works with both men and women, the position of modern women is of particular concern, and to that end the center works closely with student groups interested in women's programs and studies.

Office of Placement Services. The Office of Placement Services is the liaison between the University community and potential employers in business, education, and government. The purpose of the office is to help Duke students obtain employment consistent with their qualifications, interests, and desires. An extensive file of openings for permanent and part-time employment is available, as well as a library of general information about careers and employers. Information about summer employment opportunities is also available. Students interested in interviews with representatives from business and industry, schools and colleges, government agencies, and

graduate schools should register with the office early in the year. Representatives begin coming to Duke on October 1.

Part-time employment listings for the campus and Durham area are maintained in the office. All students interested in working during the school year should register at the beginning of the semester. Every effort will be made to help each student find a job consistent with his career interests. Interviews are available at any time to all Duke students to discuss career plans, permanent and part-time employment opportunities, interviewing techniques, and other related matters.

Judicial System and Regulations

Duke University expects and requires of all its students full cooperation in developing and maintaining high standards of scholarship and conduct. Each student is subject to the rules and regulations of the University as currently in effect or as put into effect from time to time by the appropriate authorities of the University. At the same time, the individual is responsible for decisions and choices within the framework of the regulations of the community as Duke does not assume *in loco parentis* relationships.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take disciplinary action, including suspension or expulsion, for failure to abide by the regulations or for other conduct adjudged unsatisfactory or detrimental to the University.

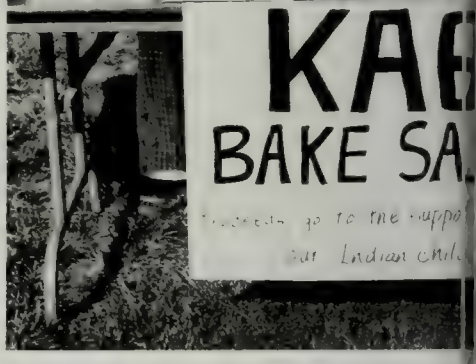
Responsibility for prescribing and enforcing rules and regulations governing student conduct rests ultimately with the Board of Trustees of Duke University and, by delegation, with administrative officers of the University and of the schools and college. In the undergraduate units, as well as the University as a whole, many of these rules have been established over the years by cooperative action between students and administrative officers and, in the case of some rules, with participation of faculty members as well. Representative student organizations, such as student governments and judicial boards, and more recently, community-wide bodies of students, faculty, and administrators, have initiated proposals for policies and rules necessary to assure satisfactory standards in academic and non-academic conduct. These proposals have been accepted by University officers and have become a substantial, if not all-inclusive, body of rules governing student life at Duke. For current regulations, the *Bulletin of Information and Regulations* should be consulted.

Students in Trinity College of Arts and Sciences, the School of Engineering, and the School of Nursing constitute an undergraduate community whose members are subject to the Undergraduate Community Code. Violations of the code and certain University regulations are adjudicated before the Undergraduate Judicial Board, composed of representatives of the student body, the faculty, and the administration. The constitution of the Board, the Judicial Code of the Undergraduate Community, and the procedural safeguards and rights of appeal guaranteed to students are published in the *Bulletin of Information and Regulations* for the undergraduate college and schools. As provided under the judicial structure of the University, each residential unit has a Judicial Board which has jurisdiction over all offenses involving violations of regulations relating to dormitory procedures and social regulations not covered by the Undergraduate Community Code or University policies and regulations. The Judicial Board of the Student Government As-









sociation of the School of Nursing (NSGA) has the major role in supervising phases of community living which directly concern the welfare of the students in the School of Nursing.

Student Activities

Office of Student Activities. The Office of Student Activities has as its responsibility the coordination and advising of those activities, undergraduate and graduate, that transcend the individual college and schools with a major emphasis on the development of the full range of these activities as they relate to the educational function of the University. In addition, this office is responsible for giving financial advice and coordination in cooperation with the Controller's office.

Associated Students of Duke University. The Associated Students of Duke University (ASDU), composed of representatives of each of the undergraduate living groups on campus and representatives of students living off campus, is responsible for the articulation of student thought and opinion on University-wide matters and for the shaping of student opinion toward constructive changes in the educational process and University environment.

The working philosophy of ASDU is that students have the right to make those decisions which primarily affect students. The purpose of student government on the Duke campus is to generate with a combination of imagination and energy, a cooperative spirit which provides the means and resources to allow every student to become a motive force in the University.

The ASDU Legislature is composed of representatives of each of the undergraduate living groups on the campus, representatives of students living off campus, and of representatives from among the transfer students. First, it fulfills an administrative role, chartering student organizations, regulating student elections, and certain aspects regarding conduct. Second, it attempts, as a student voice, to discern problems of primary concern to the student body and to take positive action in those areas. Third, it tries to identify subtle aspects of decision-making which underlie these problems and to focus student attention on these issues.

The Executive Cabinet is the coordinating body of all ASDU functions. It consists of the President, four Vice-Presidents (two from Trinity College of Arts and Sciences and one each from the School of Engineering and the School of Nursing), an Executive Secretary, an Administrative Secretary, and other members as appointed by the President.

Various executive committees of ASDU undertake projects for the direct benefit of the student body, such as those concerned with residential life, academic affairs, admissions, etc. A budget commission allocates all student fees to the various student organizations.

Cultural and Social Organizations. The scope of the more than one hundred student organizations is suggested by a partial listing of the following activities: Association of African Students, Alpha Phi Omega service fraternity, Bridge Club, Chess Club, Campus Crusade for Christ, Cheerleaders, International Club, Karate Club, Outing Club, Sailing Club, Students for a Democratic Society, Women's Liberation, Young Americans for Freedom, and the YM-YWCA. Sixteen national and three local social fraternities, as well as eight social sororities, are represented on campus and governed by Interfraternity and Pan-Hellenic Councils.

Many opportunities are provided on campus in the area of music and drama. The Duke Chorale, the Chapel Choir and Chancel Singers, the Wind Symphony, Pep Band, Symphony Orchestra, and the Madrigal Singers are examples of musical activities. Duke Players performs established and experimental drama; Hoof 'n' Horn presents musical comedy.

Most academic departments sponsor organizations and programs for students with special academic or professional interests. There are also academic and leadership honorary societies.

The Union Building, located on the West Campus, is the center for student activities. It houses, among other groups, the University Union which brings students together in carrying out its stated purpose—to stimulate, promote, and develop the social, recreational, cultural, educational, and spiritual activities of the Duke University community. The Union sponsors a broad program including lectures, concerts, recreational activities, dances, and exhibits adapted to the leisure time interests and needs of individuals and diverse groups within the University and Durham communities.

In one section of the West Campus Union are housed dining facilities, University store, grill, beer hall, soda fountain, post office, barber shop, bank, and ballroom. Elsewhere in the building are student organization offices, meeting rooms, and information center, music and reading lounge, and recreational areas. Similar services and activity areas are provided on the East Campus.

Office of Cultural Affairs. The Office of Cultural Affairs is responsible for the coordination of many of the cultural and popular entertainments which take place on the campus. The office is directly responsible for the Duke

Artists Series and Quadrangle Pictures (35 MM film program) and schedules and directs the use of Page Auditorium. Advance tickets for most events scheduled in Page Auditorium are sold at Page Box Office. The Office of Cultural Affairs also publishes yearly and weekly editions of the *Duke University Calendar.*

Media. The Duke *Chronicle,* the campus newspaper, is published five times weekly, and the student-operated FM and companion AM radio station, WDBS, produces daily programs. Three magazines and a comprehensive yearbook are published by students for all students. These publications are under the direction of a Publications Board empowered to choose the editors and business managers and to review and approve the financial statements of all franchised publications.

The *DukEngineer* is the official student-published magazine of the School of Engineering. It appears twice each semester and contains articles on technical and semi-technical topics and other matters of interest to the School.

The Charge is the student undergraduate handbook of the School of Nursing which is published by students annually. It contains information and regulations which pertain to students within the School of Nursing.

Recreational Activities and Intramurals. The Duke recreation and intramural programs provide all students an opportunity to participate in some form of informal and competitive physical activity.

The men's program consists of seventeen different activities which include archery, bowling, cross country, golf, handball, horseshoes, tennis, flag football, badminton, paddle ball, basketball, swimming, table tennis, volleyball, wrestling, softball, and track. In a typical year more than 3,000 students compete for the many intramural titles and trophies that are awarded. Each year Duke, North Carolina, North Carolina State, and Wake Forest meet in the annual Big Four Intramural Day.

The women's program encompasses competition in badminton, basketball, bowling, tennis, and volleyball. In addition, special events in other areas of interest are conducted, and various clubs including modern dance, water ballet, and other sports offer the student opportunities to take part in extracurricular activities.

Through coed intramurals, the student is encouraged to participate on a less competitive level promoting relaxed social as well as physical activity. Opportunities for coed competition are provided in the areas of badminton, table tennis, tennis, and volleyball. Numerous other activities are being planned so that women will have opportunities similar to those available for men.

The University's varied athletic and recreational facilities and equipment are available for use by the students. The facilities for recreation include a golf course, lighted tennis courts, three swimming pools, a student activities building, three gymnasia, outdoor handball and basketball courts, an all-weather track, and numerous playing field and informal recreational areas. A variety of clubs dealing with archery, gymnastics, scuba diving, sailing, cycling, badminton, karate, rugby, soccer, and other activities are available to interested students.

Intercollegiate Athletics. Duke is a member of the National Collegiate Athletic Association, the National Association of Intercollegiate Athletics for Women, and the Atlantic Coast Conference (ACC). The ACC consists of Clemson, Duke, Maryland, North Carolina, North Carolina State, Virginia, and Wake Forest.



The intercollegiate program for men at Duke University offers twelve varsity sports. They are football, cross country, soccer, basketball, swimming, fencing, wrestling, track, baseball, golf, tennis, and lacrosse. Freshmen are eligible to participate on all varsity teams. Freshman and junior varsity programs are provided in football and basketball.

The director of men's athletics provides departmental leadership and coordinates all athletic policies with the University Athletic Council. The Council consists of representatives from the undergraduate student body, the faculty, the administrative staff, and the alumni. They meet with the Director of Athletics periodically during the school year to discuss the athletic programs and make recommendations concerning athletic policies. The Chairman of the Council is appointed by the President of the University, and he is the official University representative at national and conference athletic meetings.

The women's athletic program, a function of the Women's Physical Education Department, provides intercollegiate competition in eight sports: basketball, fencing, golf, gymnastics, hockey, swimming, tennis, and volleyball. The teams are coached and/or advised by members of the Women's Department or other appropriately trained personnel. One member of the staff serves as athletic coordinator.



Admission



Principles of Selection

James B. Duke, in establishing his Indenture of Trust, requested that "great care and discrimination be exercised in admitting as students only those whose previous record shows a character, determination, and application evincing a wholesome and real ambition for life." In this light and in view of the institution's limited enrollment, Duke University looks beyond the basic characteristics of academic competence possessed by the majority of applicants. It seeks in each prospective student, regardless of race, sex, color, religion, or national origin, evidence not only of intellectual promise and maturity of judgment, but also a degree of positive energy. Often, this energy is expressed in the form of special talents and accomplishments, but is consistently seen in a student's determination to make creative use of the opportunities and challenges posed by Duke University.

Requirements for Application

Although there are no inflexible subject matter requirements, students are urged to formulate a high school program of breadth and challenge. At least 12 units of acceptable college preparatory work must be presented for review. Applicants for the School of Engineering are advised to take 4 units of mathematics and at least 1 unit in physics or chemistry.

The Scholastic Aptitude Test given by the College Entrance Examination Board and three Achievement Tests (one of which must be in English composition) are required of all candidates for freshman admission and must be taken by the application deadline. Since placement in language study can be determined by an achievement test score, it is recommended that a candidate who expects to continue study in a foreign language take the CEEB Achievement Test in that language. Candidates for the School of Engineering are required to take an Achievement Test in mathematics.

Application Procedures

Application forms and a *Bulletin of Information for Prospective Students* may be obtained from the Office of Undergraduate Admissions, Duke University, Durham, North Carolina 27706. A non-refundable processing fee of $20 must accompany the completed application form.

A personal interview at Duke is not required for admission; students who find it possible to visit the campus, however, may write for an interview or participate in one of the group information sessions held during particularly busy periods. Interviews cannot be guaranteed during the early months of the calendar year when applications are under review.

April Notification. Candidates for admission to the freshman class must apply no later than February 1 of their senior year in secondary school and normally do so during the preceding autumn. Decisions are mailed from the University by April 15, and accepted candidates are expected to reserve a place in the class by May 1.

February Notification. The student who indicates on his application that he wishes to learn his admission decision by February 1 of his senior year must observe a December 15 application deadline. Results of Scholastic Aptitude Tests and achievement tests taken through December may be submitted for review. Applicants for February notification are urged to apply concurrently to other colleges, although those who are accepted by Duke in February must pay the registration and room deposit fees by February 15 in order to reserve a place in the class. Because neither of the two notification dates is designed to be more competitive than the other, students who receive negative decisions in February should not request that their applications be reviewed once again in April.

Midyear Admission. Midyear admission allows a limited number of freshmen to begin their college work a semester early or to postpone matriculation for a semester. Midyear applicants are expected to complete all the requirements set forth for fall admission. The application deadline for new candidates is October 15; students will be notified of the decision on their applications by November 15 with the expectation that those who are accepted will reply by December 1.

Admission by Transfer. Admission by transfer from other accredited institutions may be arranged for a limited number of students each semester. Because the transcript of at least a full year of academic work is preferred by the Admissions Committee and because transfer students are required to spend their last two years at Duke, most candidates apply to Duke during their third or fourth semester in college. Candidates submit official transcripts of all work completed at other accredited colleges, scores on the Scholastic Aptitude Test, and employment records if there has been an extended period of employment since graduation from secondary school. See page 35 concerning evaluation of transfer credit.

All transfer students should expect to be responsible for their own housing arrangements. The Office of Housing Management provides assistance to students who seek housing and/or roommates.

September transfers observe the February 1 application deadline, learn of their decisions by April 15, and respond to the University by May 1. January transfers apply by October 15, learn of their decisions by November 15, and reply to the University by December 1. Transfer students for the School of

Nursing are accepted for September Admission only, and must complete all transfer application processes by March 1.

Nondegree Students. A few individuals are permitted to enroll as nondegree students in most of the courses open to degree students, but under no circumstances can places in courses be preempted for them. These students are given academic and career counseling by the Center for Career Development and Continuing Education and are subject to most of the regulations set forth for degree candidates. Nondegree applications may be obtained from the Office of Undergraduate Admissions and should be submitted to that office, accompanied by a $20 application fee, by July 15 for the fall semester and by December 1 for the spring semester.

At least eight courses must be completed successfully before a nondegree candidate may apply for degree candidacy. Students who plan to complete the eight courses should not expect automatic admission to the University. More detailed information is available from the Center for Career Development and Continuing Education, East Duke Building, Duke University, Durham, North Carolina 27708.

Readmission of Former Students. A student who desires to return, following withdrawal from college, should apply to the dean of his college. See page 46 for readmission procedures and dates. Students who have been withdrawn from the University for five or more years must submit a new application to the Director of Undergraduate Admissions.





Financial Information



Tuition and Fees

No college or university can honestly state that an education at the college level is inexpensive. Yet, fees paid by students cover less than half the cost of their instruction and the operation of the University. Income from endowment and contributions from alumni and other concerned individuals meet the balance and assure each student the opportunity to pursue an education of unusually high quality.

Students are urged to give their attention first to the selection of institutions which meet their intellectual and personal needs, and then to the devising of a sound plan for meeting the cost, including a knowledge of the University's financial aid program, as well as the family's own resources. A brochure describing in detail the various forms of financial aid may be obtained from the Office of Financial Aid, Duke University, Durham, North Carolina 27706.

Estimated Expenses for an Academic Year.* Certain basic expenditures such as tuition, room, and board are to be considered in preparing a student's budget. These necessary expenditures, with a reasonable amount allotted for miscellaneous items, are shown below:

Tuition (1974-75)	$2,780†
Residential Fee (1975-76)	
Single room	$677-$824
Double room	$505-$615
Food (1975-76)	
Seven-day board plan	$807
Five-day board plan	$694
Cafeteria estimate	$860
Books and Supplies (1975-76)	$200

*The figures contained in this section are projected and are subject to change prior to the beginning of the fall, 1975, semester.

†For juniors and seniors in the School of Nursing, the tuition is $2,900 for 1974-75.

Tuition for 1975-76 has not yet been determined. In recent years annual tuition increases have been approximately $200; it is anticipated that the increase in 1975-76 will be at least that much. It should be realized that additional expenses will be incurred which will depend to a large extent upon the tastes and habits of the individual. It is realistic to suggest that the average Duke student, however, can plan on a budget of $5,100 for the academic year. Travel costs, clothing purchases, and other major expenditures would have to be added to this estimate.

Debts. No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

Bills may be sent to parents or guardians provided the Bursar has been requested in writing to do so. Failure to pay bills on or before the due dates will bar the student from class attendance until the account is settled in full.

Tuition. The tuition charge per semester (see pg. 71) is due and payable not later than the day preceding the first day of classes for a particular semester.

Registration Fees and Deposits. On notification of acceptance, students are required to pay a nonrefundable first registration fee of $20 and to make a deposit of $100. The deposit will not be refunded to accepted applicants who fail to matriculate. For those who do matriculate, $50 of the deposit serves as a continuing room deposit for successive semesters, and the remaining $50 serves as a continuing registration deposit.

Late Registration. Students who register in either semester at a date later than that prescribed in the Calendar must pay to the Bursar a fee of $10.*

ROTC Deposit. An Air Force ROTC deposit of $10 is required of students enrolling in air science to cover possible loss of military equipment issued to them. This deposit is refunded to the student upon return of issued equipment.

School of Nursing. Special nonrefundable laboratory and health fees are charged as follows: sophomores—$50; juniors—$25; seniors—$50. The health portion of this fee is not a student health insurance fee, but a charge which covers X-rays, laboratory tests, and a physical examination for students at their entry and exit points of clinical experience. These physical examinations must be conducted at Duke University. A declaration of satisfactory health is required by the School (1) for personal protection of the student, (2) by affiliating clinical agencies, and (3) for nurse registration applications at completion of the program. The laboratory portion of the fee includes the cost of a stethoscope in addition to other items. Additional medical fees may be required for certain nursing electives.

Part-time Students. In the regular academic year students who register for no more than two courses in a semester are classified as part-time students. Part-time students will be charged at the following rates: One course, $280; half-course, $140; quarter-course, $70; one course plus laboratory or precept, $375 (see above).* Registration for more than two courses requires payment of full tuition. Graduate students registered for undergraduate courses will be assessed 3 units for non-laboratory courses and 4 units for laboratory courses. Nondegree men and women students beyond usual college age who are on review for admission to degree programs, as designated by the Office of Continuing Education, pay fees by the course whether the course load is one, two, or three courses.

*This fee will be increased for 1975-76.

Auditors. Auditing of one or more courses without charge is allowed students paying full fees, provided that the consent of the instructor is obtained. Students who are enrolled for one or two courses may audit other courses by payment of $40 for each course audited. With the consent of the appropriate instructor and the Director of Career Development and Continuing Education, graduates of Duke may audit undergraduate courses for $40 per course.

Duke Employees. Full-time employees with one or more years of service with the University may request permission to take for credit or audit up to two courses during any one semester. Permission may be granted based on the individual merits and circumstances of each application. Employees receiving permission to take such courses for credit will be charged one-half of the tuition rate for part-time students as shown above. Courses may be audited upon payment of $20 per course.

Fees for Course Changes and Transcripts. Changes in registration for courses for reasons not arising within the University require a payment of $1 for each change made. Requests for transcripts of academic records should be directed to the Office of the Registrar. Ten days should be allowed for processing. A minimum fee of $2, payable in advance, is charged for a single copy. A charge of fifty cents will be made for each additional copy on the same order to the same address.

Living Expenses*

Housing. In the residence houses for undergraduate students other than nurses, the residential fee for a single room ranges from $677 to $824 for the academic year; for a double room, the fee ranges from $505 to $615 per occupant. In the Graduate Center, the residential fee for a single room is $558 for the academic year; for a double room, it is $416 for each occupant.

The residential units of the School of Nursing are Hanes House and Hanes Annex. The residential fee for a single room is $738 for the academic year; for a double room, it is $550 for each occupant.

Detailed information concerning the student's obligations under the housing contract and the consequences of failure to comply are published in the *Bulletin of Information and Regulations.*

Food Services. See Food Services on page 58 for a description of dining facilities on both campuses and the options or requirements for board contracts. The charge for board is $403.50 per semester on the seven-day plan or $347 per semester on the five-day plan, payable at the time of registration.

Refunds

If a student withdraws, he or his parents may elect to have tuition, as well as room and board (if applicable), held as credit for later study, or refunded according to the following schedule:

Withdrawal	*Refund*
Before classes begin	Full amount
During first or second week	80%
During third to fifth week	60%
During sixth week	20%
After sixth week	None

*The figures contained in this section are projected and are subject to change prior to the beginning of the fall, 1975, semester.

In the event of death, or involuntary withdrawal to enter the armed services, refunds will be made on a pro rata basis.

The $50 registration deposit will be refunded to students (1) whom the University does not permit to return, (2) who graduate, or (3) who request the refund prior to registration, thus indicating their intention not to return for the following semester. The registration deposit will not be refunded to students who register but fail to enter the following semester on schedule.

Arrangements for refund of the $50 room deposit are described in information furnished each student by the Housing Bureau.

Student Aid

It is the policy of Duke University to provide adequate financial aid for all students when evidence of need exists. The amount of financial assistance approved for an individual varies directly with his financial need determined according to widely accepted principles recommended by the College Scholarship Service.

For the student with demonstrated need, the net cost of an education at Duke University will generally be no greater than that for college attendance at a private institution elsewhere. It is the intention of the Financial Aid Office to set each award at a level which will enable a student to meet all the costs of attending Duke University, taking into consideration the contribution that can reasonably be expected from the student, his family, and any available outside sources.

During the current academic year, approximately one-third of the student body received more than three million dollars in scholarships or loan funds.

Financial Aid for Entering Freshmen. Candidates should initiate their application for financial aid concurrently with their application for admission during the fall semester of their senior year in secondary school. Instructions concerning the specific requirements and deadline dates will accompany the application materials. The Parents' Confidential Statement must be submitted to the College Scholarship Service. This form may be obtained either from a high school guidance counselor or from the Financial Aid Office, 614 Chapel Drive, Durham, N. C. 27706. A certified copy of the parents' current Federal Income Tax Form 1040 must also be submitted.

A student in residence who is receiving financial assistance based upon need may not register an automobile on campus during the academic year for which the aid is granted without special permission for an appropriate reason.

Renewal of Financial Aid after Freshman Year. Each year students must file an application for renewal of financial aid. This application must include a new Parents' Confidential Statement and a certified copy of the parents' current Federal Income Tax Form 1040.

In order for financial aid to be renewed, a student must be in good academic standing with the University. A.B. Duke and J.A. Jones Scholars are expected to maintain considerably higher than a minimum average. If it is necessary for a student to receive an *I* (incomplete), an *X* (absence from final examination), and a *W* (withdrawn) on his report he must consult his academic dean.

Types of Financial Aid. Gift scholarships or grants, long-term loans, and employment are integral parts of the financial aid program, and some portion of the aid offered an undergraduate will normally be in each of these forms. In 1974-1975, the self-help portion consisted of a $600 loan and a job paying

$650. Acceptance of a gift scholarship does not require the student to undertake the loan or job portions of his award. Duke has several scholarships based on need which are available annually from personal endowments and corporation sources. Some are designed for entering freshmen, whereas others are awarded to upperclassmen. These scholarships may be based upon achievement in a particular field or an overall outstanding record.

Gift Scholarships. The following are among the named gift scholarships offered through Duke University:

Angier B. Duke Memorial Scholarships. Recipients of these awards are students whose superior records mark them as young men and young women who give outstanding promise of becoming leaders in their chosen fields of endeavor. Candidates for admission to the freshman classes in Trinity College of Arts and Sciences, the School of Engineering, and the School of Nursing are eligible to apply. Forty are usually available for each freshman class with a value of $500 to $4,300 annually, depending upon financial need.

W. N. Reynolds Memorial Scholarships. Recipients of these awards are students of outstanding ability and need who have made superior records and show promise of constructive leadership. In considering candidates for the awards, consideration will be given in the following order:

1. Children of employees of R. J. Reynolds Tobacco Company or any of its affiliates or subsidiaries.
2. Children of families residing in Forsyth County, North Carolina.
3. Other candidates who are residents or natives of North Carolina.

Number available: Four for each freshman class.
Value: $500 to $4,300 annually.

United Methodist Scholarships. A number of United Methodist Scholarships, valued at $500 per year, are available on a basis of demonstrated need to Methodist students who have given evidence of leadership in their local Methodist Youth Fellowship Groups.

Alice M. Baldwin Scholarships. One or more of these scholarships, varying in amount from $200 to $2,000, are awarded to rising seniors in Trinity College of Arts and Sciences on the basis of scholarship, character, and leadership.

Evelyn Barnes Memorial Scholarship. One $400 or two $200 grants are awarded to undergraduate women who are contributing to the musical life of the University. Scholarship, character, and leadership are considered. Recommendation by a member of the music faculty or by the Director of the Chapel Choir is required.

Panhellenic Scholarship. A scholarship of approximately $500 is awarded to an upperclass woman student in Trinity College of Arts and Sciences on the basis of scholarship, character, leadership, and service.

Delta Delta Delta Scholarship. A scholarship of $200 is awarded by Delta Delta Delta to an undergraduate woman on the basis of scholarship and character. The winner of this award is eligible to compete for the national award of a Delta Delta Delta Scholarship of $1,000.

Sandals Scholarship. A scholarship of approximately $200 is awarded to a rising sophomore woman in Trinity College of Arts and Sciences, on the basis of scholarship, character, leadership, and potential for contributions to the University community.

Welch Harriss Scholarships. These awards are made to male freshmen who have achieved outstanding academic records and who demonstrate financial need. They are renewable each year as long as the student remains in good academic standing. Consideration will be given in the following order: (1) students from High Point; (2) students from Guilford County, North Carolina; and (3) students from North Carolina. Number available: three for each freshman class.

Florence K. Wilson Scholarships. Grants-in-aid are made each year from the Florence K. Wilson Scholarship Fund to nursing students qualifying for financial assistance. This fund was established in 1961 by combining the School of Nursing's Alumnae Association Fund, the students' Florence K. Wilson Scholarship Fund, and contributions from the Wilson family and friends.

Alyse Smith Cooper Scholarships. Each year six or more scholarships of various amounts are awarded to students demonstrating both talent and need. Preference is given to students from Alamance County, North Carolina. Especially considered are majors in music and art, particularly students of piano, organ, and voice.

Braxton Craven Endowed Scholarships. Scholarships up to the amount of tuition are awarded to outstanding students, with first preference given to Davidson County, North Carolina, residents and second preference to students from North Carolina. The scholarships are approved on a continuing basis, providing satisfactory academic progress is achieved.

Marian Sanford Sealy Scholarship Fund. Established in 1966 with an initial gift from the Durham-Orange County Medical Auxiliary, the Marian Sanford Sealy Scholarship is awarded to a student indicating financial need. Personal qualifications supportive of potential to become an outstanding nurse and a distinguished academic record are the criteria for the recipient of this scholarship.

Lelia R. Clark Scholarship in Nursing. The Duke Hospital Auxiliary established the Lelia R. Clark Scholarship in Nursing in 1971 to cover tuition and fees for a nursing student, preferably one from North Carolina. Prerequisites for the award are a commendable academic record, financial need, and exemplification of the qualities of a person committed to serving others.

Federal Nursing Grants. Funds provided by the federal government are available in limited amounts for grant awards to qualified nursing students.

J. A. Jones Memorial Scholarship. The scholarships, sponsored through the Jones Fund for Engineering, are awarded to engineering students whose outstanding academic and personal qualifications suggest that they will become leaders in a technological society. The awards range from a yearly sum of $500 to $3,600, depending on the degree of need. The Jones Scholarships, granted for the first year without regard to the student's intended major within engineering, are renewable on the same terms for the second year as long as the student does satisfactory work. For the last two years, they are limited to majors in civil engineering.

Robert H. Pinnix Scholarships. The Robert H. Pinnix Scholarships are awarded annually to two upperclassmen enrolled in the Duke School of Engineering. The award is based upon demonstrated ability, excellence in engineering, and financial need.

Scholarships for Foreign Students. A limited number of awards will



be made each year to qualified students from other countries who enter either as freshmen or as students with advanced standing. Candidates for these awards are required to submit the Application for Scholarship and Financial Aid and the Parents' Confidential Statement of the College Scholarship Service provided by the Admissions Office of Duke University. Two named awards bring foreign students to the campus: the Carol Cranmer Scholarship (named for a former student) and the Roberta Florence Brinkley International Scholarship (named for a former dean).

The Mary Duke Biddle Scholarship in Music Composition. This scholarship with a stipend of $2,500 per year is available to a member of each entering class. It is renewable from year to year so long as the student does satisfactory work. The student wishing to apply for this award will be required to submit examples of his music composition. Eligibility is limited to students planning to major in music.

Huguenot Scholarship. A scholarship of $1,000 per year is available from the Huguenot Society of America to a descendant of a Huguenot.

AFROTC College Scholarship Program. Beginning in the second semester of their freshman year, cadets are eligible to compete for AFROTC College Scholarships. These scholarships include tuition, books, laboratory fees, and a $100 monthly stipend. The scholarship is awarded on a merit basis and considers academic achievement, leadership potential, and overall performance. The scholarship can become effective in the sophomore or junior year.

NROTC College Scholarship Program. This scholarship program provides for four years' tuition and textbooks at government expense plus subsistence and summer active duty pay. Selection for this program is made during the senior year in secondary school through a nationwide selection process.

Loans. The loan programs which are available to students through Duke University are listed below:

National Direct Student Loan Program. Loan funds supplied by the federal government through Part E of Title IV of the Higher Education Act of 1965 are available to qualified students. Repayment of loans under this Act normally begins nine months after the student graduates or leaves college, with complete payment scheduled within a ten year period. Interest accrues at the rate of 3 percent annually commencing nine months after the borrower ceases to be a full-time student at an institution of higher education. This loan is part of the student's financial aid award.

Nursing Loans. Loan funds supplied by the federal government are available to qualified students in the School of Nursing. Interest accrues at the rate of 3 percent annually commencing nine months after the student ceases to be a full-time student. A certain percentage of the loan is forgiven for each year the student serves as a professional nurse. This loan is part of the nursing student's financial aid award.

Federal Guaranteed Insured Loan Program. Under the Higher Education Act of 1965 Congress established the Federal Guaranteed Insured Loan Program, designed to guarantee and insure student loans. These loans are made by banks or other incorporated state lending agencies, with enrollment of the student certified by the school or college. The interest is 7 percent. Students who qualify will have the interest paid by the government while they are in school. Duke University is a guaranteed lender.

Deferred Tuition Loan Program. A program of deferred tuition is available as a plan through which a sophomore, junior, or a senior may defer payment of tuition until after graduation. Payment may be made by paying 8 percent interest on the amount borrowed as a regular loan. Financial need is not required to receive this loan. Interested students should contact the Office of Undergraduate Financial Aid.

Remission of Tuition. Children of ministers in the North Carolina and the Western North Carolina Annual Conferences of the United Methodist Church may be eligible to receive a remission of the tuition charge for a maximum of eight semesters of undergraduate study at Duke University. Eligibility is met by the parent being in a regular pastoral appointment and resident in one of the conferences; when the parent is in a special appointment and resident in one of the conferences, eligibility will be determined on an individual basis depending upon the nature of the appointment. In all cases the decision of the University will be final.

Employment. Most financial aid recipients are offered a job as part of their aid package. These jobs require between nine and fifteen hours a week and provide an average stipend of $600. The money is paid directly to the student. The Office of Placement Services maintains part-time employment listings for the campus and Durham area. All students interested in working during the school year should register at the beginning of the semester. Every effort will be made to help each student find a job consistent with his career interests.

Duke University also expects that students receiving financial aid will work during their summer vacation. In the summer before entering college, a freshman should save $400 for use during his first year of college. In subsequent summers, the student should save $600 to be used for college expenses.

Paying the Bills. Many families finance a college education with the assistance of an insured tuition payment plan regardless of whether they receive financial assistance from Duke. Although these plans are sponsored by a number of private firms, the University refers parents to plans provided by the Richard C. Knight Insurance Agency, Inc. The company provides the University with the full sum required each semester and arranges a schedule for monthly repayment by the subscribing families. The schedules for repayment vary with the programs offered by the company. Additional information on this particular tuition payment plan may be obtained by writing to Richard C. Knight Insurance Agency, Inc., Insured Tuition Payment Plan, Sixth Street-James Avenue, Boston, Massachusetts 02116.





Courses of Instruction



Definition of Terms

Introductory-level courses are numbered below 100; advanced-level courses are numbered 100 and above. Courses numbered 1 through 49 are primarily for freshmen; courses numbered from 200-299 are primarily for seniors and graduate students. (See page 37 for regulations governing enrollment of other students in 200-level courses.)

Odd-numbered courses are usually offered in the fall semester; even-numbered courses in the spring semester. For courses which will be offered in 1975-76, consult the Official Schedule of Courses, available in the Registrar's Office.

Double numbers separated by a hyphen indicate that the course is a year course and must normally be continued throughout the year if credit is to be received. Double numbers separated by a comma indicate that although the course is a year course, credit may be received for either semester without special permission.

When S is prefixed to course numbers a summer session offering is designated. The following symbols, suffixed to course numbers, identify the small-group learning experiences: *S*, seminar; *P*, preceptorial; *T*, tutorial; *D*, discussion section.

Air Force Aerospace Studies

For courses in Air Force Aerospace Studies, see the Reserve Officers Training Program.

Anthropology

Professor Friedl, *Chairman*; Associate Professor Apte, *Director of Undergraduate Studies;* Professors Fox and LaBarre; Associate Professors Cartmill, Hylander, O'Barr, and Rosen; Assistant Professors Boon, Casson, Quinn, and Smith

93. Human Origins. Origins and distribution of mankind; primate evolution; a survey of human paleontology and human biology, prehistory, and language; and the origins of human social organization and culture. One course. *Staff*

94. Elements of Cultural Anthropology. The dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. Primarily meant for students not majoring in the social sciences. One course. *Staff*

99. Cultural Anthropology. Introductory study of culture, society, and human behavior with emphasis on theory and ethnography. Designed for social science majors and required for anthropology majors. One course. *Staff*

101, 102. Introduction to the Civilization of Southern Asia. (See Interdisciplinary Course 101, 102.)

107. Introduction to Linguistics. Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. Prerequisite: sophomore standing. (Also listed as English 107.) One course. *Apte, Butters, Casson, or Hull*

115. Sex Roles in Evolutionary Perspective. Bases for differentiation of tasks and power allocated to the sexes among hunters and gatherers, horticulturists, pastoralists, and plow agriculturalists. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Friedl, Quinn, or Smith*

119. Language, Culture, and Society. Analysis of language behavior within and across societies relating variations in linguistic usage to sociocultural factors: ethnosemantics, social dialects, ethnography of speech, language standardization, multilingualism, language loyalties, problems of lingua franca, language planning, and policies in developing nations. Prerequisite: Anthropology 107 or permission of the instructor. One course. *Apte, Casson, or Rosen*

120. Comparative Language. Anthropological study of human and prehuman non-verbal communication; sound, sense, and structure in Indo-European and other languages; techniques of reconstructing the ethnographic past (philology, glottochronology, paleolinguistics); and an introduction to psycholinguistics and sociolinguistics. One course. *LaBarre*

123. Peoples of the World: Mediterranean Europe. Emphasis on economic developments and change in rural communities and on the urbanization of migrants. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Friedl*

124. Peoples of the World: American Indian. A comprehensive survey of the Indians of North and South America, including a study of origins and prehistory, archaeology, racial affiliations, languages, material culture, social and political organization, economics, and religion, discussed in terms of the "culture area." One course. *LaBarre*

125. Peoples of the World: Africa. A survey of the indigenous cultures and societies of Africa and the study of kinship, politics, economics, religion, and sociocultural change. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *O'Barr*

126. Peoples of the World: Oceania. Selected problems in the development of pre-European and post-European cultures. The relationships between man and Pacific environments. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Staff*

127. Peoples of Mesoamerica. Development and organization of diverse societies and institutions in Mexico and Guatemala. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Smith*

129. Peoples of the World: Middle East. Emphasis on language, kinship, economics, politics, and religion. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Casson or Rosen*

130. Social and Cultural Change. Contemporary theories of change, including innovation, acculturation, and modernization. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *O'Barr or Smith*

134. Political Anthropology. Comparative study of politics and government in tribal and peasant societies. Evolution of political systems. Political changes resulting from contact and colonialism. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *O'Barr or Smith*

135. Anthropological Research in American Culture. Substructures in American society studied by ethnographic field methods. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Quinn*

137. Kinship and Social Organization. Anthropological study of kinship relations and social groups: family, marriage, residence, terminology, descent, and alliance. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Casson*

141. Peoples of the World: Southeast Asia. Major social, cultural, and religious systems—Hindu-Buddhism and Islam—and examples of populations relatively isolated from the historical expansion of these systems. Emphasis placed on island Southeast Asia. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Boon*

142. Peoples of the World: South Asia. Survey of indigenous cultures and societies of India, Pakistan, Sri Lanka, Bangladesh, Nepal, and Bhutan with emphasis on social institutions, behavioral patterns, value systems, and sociocultural change. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Apte or Fox*

162. Cultural Ecology. Human interaction with environment, and the effect of ecology on social structure. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Smith*

164. Peasantry and Peasant Movements. The genesis of peasant movements. Forms of peasant protest and its role in the economic, political, and ritual life of societies. Case studies from Western and Eastern societies, past and present. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Fox or Smith*

165. Psychological Anthropology. The mutual relevance of anthropology to child development, social learning, small-group interaction, cognition. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Quinn*

166. Introduction to Archaeology: Man and Culture. Modern methodology and analysis; theories of cultural evolution; survey of world prehistory with an exploration of the uses of ethnographic analogy. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Staff*

170. Economic Anthropology. Traditional economic systems, including land tenure, division of labor, exchange, leveling mechanisms and markets; and the response of traditional economies to modern forces such as population pressure, migratory labor, plantation agriculture, and agricultural innovation. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Quinn or Smith*

185T, 186T. Junior Tutorial. Prerequisites: Anthropology 94 or 99 and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

193. Independent Study. Directed reading and research. Open only to highly qualified students in the senior year, by permission of the Director of Undergraduate Studies. One course. *Staff*

195S, 196S. Senior Seminar. Prerequisites: Anthropology 94 or 99 and any two 100-level courses in anthropology, and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

199. The Changing South. (See Interdisciplinary Course 199.) One course. *Staff*

210. Linguistic Anthropology: Theory. Examination and comparison of predominant schools of language study—comparative-historical, structural, transformational, stratificational, and generative semantics. Prerequisite: Anthropology 107 or permission of the instructor. One course. *Apte or Casson*

211. Linguistic Anthropology: Ethnography of Communication. Verbal and nonverbal communication from linguistic and anthropological perspectives with emphasis on synchronic and diachronic aspects of communication, development of sociolinguistic theory and its application to intra- and intercultural communicative processes. Prerequisite: Anthropology 107 or permission of the instructor. One course. *Apte or Casson*

220S. Society and Culture in India. The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Apte or Fox*

222. Topics in African Anthropology. Research problems illustrated through ethnographic studies of African societies. One course. *O'Barr*

231. Human Evolution. Evolutionary biology of the primates. Anatomical and behavioral adaptations and phylogeny of fossil and living primates including *Homo sapiens*. Prerequisite: Anthropology 93 or equivalent. (Also listed as Anatomy 231.) One course. *Cartmill*

242. Topics in Prehistory. Anthropological issues derived from archaeological and early historical investigations. Prerequisite: Anthropology 93 and 94 or equivalent. One course. *Staff*

243. Theory and Method in Archaeology. Techniques of geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses applied to problem areas in archaeology—human cultural origins, Paleolithic and post-Pleistocene readaptations, origins of agriculture and civilization. Prerequisite: Anthropology 166 or permission of the instructor. One course. *Staff*

244. Primate Behavior. Examination of the social behavior of prosimians, monkeys, and apes in an attempt to understand the evolutionary development of the primate order and the origin of man. One course. *Staff*

245. Functional and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anthropology 231 (Anatomy 231) or equivalent, or per-

mission of the instructor. (Also listed as Anatomy 238.) One course. *Hylander and Cartmill*

246. The Primate Fossil Record. Evolution of man and other primates as inferred from fossil remains. Prerequisite: a course in human evolution or permission of the instructor. One course. *Cartmill or Kay*

249. Topics in Economic Anthropology. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *O'Barr, Quinn, or Smith*

250. The Anthropology of Cities. Organization and behavior of men in urban centers analyzed from an evolutionary perspective; cross-cultural analysis of cities and their varying roles. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Fox*

251. Ethnography of Humor. Examination of theoretical framework, research methods and data-collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Apte*

259. Linguistic Anthropology: Language Acquisition. Biological basis of human linguistic capacity; major theoretical positions in linguistics; acquisition of semantics, syntax, and phonology in English and other languages. Prerequisite: Anthropology 107 or permission of the instructor. One course. *Casson*

262. Law and Anthropology. Adjudication and dispute settlement in primitive and small-scale societies. Western legal developments compared with those of new nations. American legal problems from the anthropological perspective. Prerequisite: Anthropology 94 or 99 or permission of the instructor. One course. *Rosen*

263. Primitive Art and Music. A comparative ethnological study of non-European art and music; sufficient technical background will be provided for nonspecialist students. One course. *LaBarre*

264. Primitive Religion. The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. One course. *LaBarre*

265. Personality and Society. The sociology and social psychology of human personality, its origins in the primary group, its nature and varieties, and its integrations into secondary group institutions. One course. *LaBarre*

266. Personality and Culture. The influence of culture patterns and social institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comprehensive anthropological materials will be drawn upon. One course. *LaBarre*

267. Cognitive Anthropology. Theoretical and methodological developments in the study of taxonomies, naturally occuring categories, information-processing rules, decisions, and belief systems. Psychological testing of non-Western people; effects of schooling. Prerequisite: Anthropology 94 or 99. One course. *Quinn*

268. Law and the American Indian. Survey of the legal status and problems of the contemporary American Indian. Topics include the basis and extent of tribal sovereignty, the relation of states and their Indian citizens, treaties and Indian claims actions, the legal context of economic development, and the legal position of Eastern American Indians. One course. *Rosen*

270. Ethnographic Field Methods. Research strategies and techniques for field research; participation in a field project in a local community. One course. *Casson, O'Barr, or Quinn*

271. Methods of Data Analysis. Quantitative analysis of anthropological data. One course. *Quinn*

275. Rank, Power, and Authority in Pre-Industrial Societies. The role and development of social, economic, and political stratification in specific societies in Oceania, Africa, and the New World. Prerequisite: concentration in anthropology or graduate standing. One course. *Fox*

276. Analysis of Kinship Systems. Primitive relationship categories as related to legal norms and social groupings. Theoretical issues and contrasting approaches to the analysis of social classification terminologies. One course. *Boon or Casson*

278S. Special Topics in Political Anthropology. Current research problems. Topic(s) will change each semester. Prerequisite: Anthropology 134 or permission of the instructor. One course. *O'Barr or Quinn*

280S, 281S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Prerequisite: permission of the instructor. Two courses. *Staff*

291, 292. Anthropological Theory. Theoretical, methodological, and comparative issues. Prerequisite: permission of the instructor. Two courses. *Boon, Fox, or Quinn*

DEPARTMENTAL MAJOR

Major Requirements. Eight courses in the department, two of which must be 93 and 99 and at least two of which must be senior-graduate courses.

An anthropology major normally takes at least four related courses in departments approved by his anthropology adviser. Such courses are usually in the Departments of Anatomy, Art, Botany, Economics, History, Mathematics, Political Science, Psychology, Sociology, and Zoology.

Art

Professor Covi, *Chairman* (on leave); Professor Jenkins, *Acting Chairman;* Assistant Professor V. Pratt, *Acting Director of Undergraduate Studies;* Professors Hall, Markman, Mueller, Sunderland; Assistant Professors Brown, Lichtenstein, and Stars; Instructor Smullin; Lecturer Langedijk; Visiting Part-time Professor Huemer; Visiting Assistant Professor Connolly; Part-time Lecturer van Dijk; Part-time Instructors Menapace, S. Pratt, and White

HISTORY OF ART

Introductory courses in art history (Art 61 through 66) are designed as studies in the development of architecture, sculpture, painting, and minor arts as material manifestations of Western culture from ancient to modern times, with some reference to primitive, Oriental, and other non-Western cultures. A student receives instruction in the history of art and in methods of art historical analysis. Credit may not be allowed for more than two courses in the sequence. Introductory courses are open to freshmen, as well as upperclassmen.

Area Courses

61. Introduction to the History of Architecture and Sculpture. One course. *Staff*

62. Introduction to the History of Painting and Sculpture. One course. *Staff*

63. Introduction to Ancient Art. Architecture, sculpture, and painting from prehistoric times through the Roman period. One course. *Markman*

64. Introduction to Medieval Art. Development of architecture, sculpture, painting, and related arts, mostly Christian, from about 300 A.D. to about 1400. Prerequisite: Art 61, 62, or 63. One course. *Sunderland*

65. Introduction to Renaissance and Baroque Art. Development of architecture, sculpture, and painting in Western Europe from about 1400 to about 1750. Prerequisite: Art 61, 62, or 63. One course. *Jenkins*

66. Introduction to Modern Art. Development of architecture, sculpture, and painting in Europe and America from about 1750 to the present. Prerequisite: Art 61, 62, or 63. One course. *Brown or Connolly*

131. Art and Archaeology of the Hellenic World. Preliminary treatment of archaeological material from the Aegean, the geometric, and orientalizing periods, followed by the architecture, sculpture, and vase paintings of ancient Greece from archaic through Hellenistic times. Not open for credit to students who have taken Classical Studies 55. One course. *Markman*

132. Roman Art and Archaeology. The archaeological background for the formation of the Roman style as derived from Etruscan, Greek, and indigenous Italian sources, followed by the architecture, sculpture, and painting from the early Republic to the end of the Empire in Italy and in the provinces. Not open for credit to students who have taken Classical Studies 56. One course. *Markman*

133. Mediaeval Architecture. A survey of Christian architecture in the Near East, the Balkans, Russia, and Western Europe from the beginnings of the mediaeval style in the late classical period to its disintegration in the fifteenth century. One course. *Sunderland*

134. Mediaeval Painting and Sculpture. A study of painting, including mosaics, manuscripts, stained glass, and sculpture in Western Europe from the late classical period through the fourteenth century. One course. *Sunderland*

135, 136. Art of Northern Europe in the Fifteenth and Sixteenth Centuries. First semester: Netherlandish, French, and Spanish painting with some reference to Franco-Flemish illumination. Second semester: German, Austrian, and Bohemian painting, graphic arts, and sculpture. Two courses. *Mueller*

137, 138. Italian Renaissance Art. A consideration of Italian sculpture and painting in the fourteenth, fifteenth, and sixteenth centuries. The first semester will be devoted to the art of the fourteenth and fifteenth centuries; the second to that of the sixteenth century. Prerequisite: Art 61 or 62 or permission of the instructor. Two courses. *Jenkins*

139S. The Book as an Art Form. From hieroglyphic inscriptions to press books, with particular emphasis upon the relationship of book manufacture and design to its cultural environment. One course. *Sharpe*

140. Seventeenth Century Painting and Sculpture in Europe. Traces the evolution of the Baroque style in European painting and sculpture, with some attention being given to related manifestations in the late sixteenth and early eighteenth centuries. Particular emphasis is laid on developments in Flanders, France, Holland, and Spain. Prerequisite: Art 61 or 62 or 65 or consent of instructor. One course. *Jenkins*

141. American Art. A survey of architecture, sculpture, and painting in America from the time of the first settlers to the present day, including a consideration of the contributions of the English, Dutch, French, and Spanish to the artistic heritage of the United States. One course. *Brown or Connolly*

143S. History of Prints and Drawings. Fifteenth century to the present. Prerequisite: Art 62, 65, or 66 or permission of the instructor. One course. *Mueller*

144. Renaissance and Baroque Architecture. A study of the development of Renaissance architecture in Italy from its beginnings in the fifteenth century in the works of Brunelleschi to its flowering in the seventeenth century Baroque works of Bernini and Borromini, along with a consideration of the spread of Italian Renaissance forms to north Europe in the sixteenth century and its development into a Baroque style in the seventeenth century. One course. *Sunderland*

145S, 146S. The Rise of Contemporary Architecture. A study of the sources and evolution of the architecture of today, from the eighteenth century conflict between romantic historicism and industrialism to the work of Gropius, Le Corbusier, Wright, and their successors. Seniors graduating at midyear may receive credit for 145, which is otherwise prerequisite to 146. Prerequisite: Art 61 for 145S; Art 145S for 146S. Two courses. *Hall*

147. Painting and Sculpture in the Eighteenth and Nineteenth Centuries. An investigation of the development of painting from the final stages of the Baroque in the eighteenth century to the period of the Impressionist Movement in the last decades of the nineteenth century. One course. *Sunderland*

148. Modern Painting and Sculpture: 1863 to 1905. The rise of the anti-academic movements of Impressionism, Divisionism, Symbolism, and the Art Nouveau emphasizing Manet, Van Gogh, Gauguin, Seurat, and Cezanne. Prerequisite: Art 62 or 66. One course. *Brown or Lichtenstein*

149. Pre-Columbian Art and Archaeology. Architecture, sculpture, pottery, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region of South America before the Spanish conquest. One course. *Markman*

150. Latin American Art. Architecture, painting, sculpture, and other arts. Emphasis on the architecture of the colonial period. One course. *Markman*

165. Painting and Sculpture: 1905 to Present. Evolution and interaction of major European and American movements. Prerequisite: Art 148 or permission of the instructor. One course. *Brown*

191T, 192T. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission of the department. Two courses.

193T, 194T. Independent Study. Directed reading and research. Open

only to qualified students in the senior year, by permission of the department. Two courses.

For Seniors and Graduates

217. Aegean Art. A study of the problems of Aegean art as the forerunner of Greek art and in relation to the contemporary civilization of the Eastern Mediterranean world. One course. *Markman*

218. Early Greek Art. A study of the problems of the origin and development of Greek art in the Geometric period to the end of the Archaic period. One course. *Markman*

233. Early Mediaeval Architecture. The development of religious architecture from the time of Constantine to the end of the First Romanesque style in the third quarter of the eleventh century. One course. *Sunderland*

237. French Renaissance Art. Sixteenth century painting and sculpture in France with special emphasis on Italian influences. Prerequisites: some knowledge of Italian Renaissance art and the ability to read French, or permission of the instructor. One course. *Jenkins*

239S. Architecture of Britain. After a summary of recent archaeological activity in the British Isles and a survey of mediaeval buildings, the course deals principally with changing architectural problems and their solutions from the advent of the Renaissance onward. Attention is given to the interests of students majoring in history or literature. Prerequisite: Art 61. One course. *Hall*

240S. Architecture of North America. A study illustrating the transplantation of European architectural customs since the sixteenth century; the time-lag in transit and acceptance of later European developments; the gradual assumption of confident independence in design; and the emergence of international leaders in the United States. Prerequisite: Art 61. One course. *Hall*

241. Problems in Latin American Art. Architecture, painting, sculpture, and other arts with emphasis on colonial architecture of Central America. Open to seniors who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. One course. *Markman*

245, 246. Problems in Italian Renaissance Painting. Concentrated study of painting in one or more centers outside Florence. Prerequisite: Art 137 or 138 or permission of the instructor. Two courses. *Huemer*

247. Problems in the History of Graphic Arts. Selected topics in the history of prints and drawings. One course. *Mueller*

248. Florentine Painting During the Renaissance. Prerequisite: Art 137 or 138 or permission of the instructor. One course. *Covi*

249. Problems in Pre-Columbian Art and Archaeology. Architecture, sculpture, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region. Prerequisite: Art 149, apposite courses in anthropology or Latin American history, or permission of the instructor. One course. *Markman*

251S-252S. Research. A course designated to give instruction in methods used in the investigations of original problems. It is open to seniors by permission of the Director of Undergraduate Studies. Two courses. *Staff*

253S. Studies in Italian Renaissance Sculpture. Prerequisite: Art 137 or 138 or permission of the instructor. One course. *Covi*

255S, 256S. Iconological Problems. Subject matter and sources. Prerequisite: knowledge of two foreign languages or permission of the instructor. Two courses. *Langedijk*

257, 258. Problems in Modern Art. Selected topics in nineteenth and twentieth century European art, with emphasis on one or more major movements or masters. Prerequisite: Art 66 or 148 or permission of the instructor. Two courses. *Lichtenstein*

291S-292S. Museology Seminar. Operation of a museum; instruction in exhibition and restoration techniques, as well as registration and the researching of art objects with a view to exhibition accompanied by scholarly catalogues. Open to art majors or by permission of the instructor. Two courses. *Staff*

293, 294. Special Problems in Art History. Individual study and research. Two courses. *Staff*

DESIGN

53-54. Beginning Studio. Experiment and practice with formal elements of composition in various media. Prerequisite: permission of the instructor. Two courses. *Pratt and Smullin*

151. Photography. Emphasis on interaction of technique, perception, and communication in making and responding to photographic images. Some work with view cameras furnished by the department; students must provide own hand camera. Prerequisite: permission of the instructor. One course. *Menapace*

153, 154. Painting. Studio practice in painting with individual and group criticism and discussion of important historic or contemporary ideas in painting. Prerequisite: Art 53-54 or equivalent and permission of the instructor. Two courses. *Pratt*

155, 156. Advanced Drawing and Color. Prerequisite: Art 53-54 or equivalent and permission of the instructor. Two courses. *Pratt*

159, 160. Printmaking. Wood engraving, block printing, copperplate engraving, etching, aquatint, and drypoint. Prerequisite: Art 53-54. Two courses. *White*

161, 162. Sculpture. Realistic modeling in clay from the human model and work in abstract modes. Introduction to casting, carving, and welding. Second semester: independent problems. Prerequisites: Art 53-54, or equivalent and permisson of the instructor. Two courses. *Smullin*

164. Ceramics. The design, production, and conceptualization of three-dimensional forms. One lecture and four studio hours each week. One course. *Stars*

171, 172. Advanced Sculpture. Prerequisite: Art 161 and 162 or equivalent. Two courses. *Smullin*

173, 174. Advanced Painting. Prerequisites: Art 153 and 154 and permission of the instructor. Two courses. *Pratt*

181, 182. Individual Project. Independent work open to highly qualified seniors on recommendation of the instructor and invitation of the department. Two courses. *Staff*

ELECTIVE FOR ART MAJORS

119. Fine Arts Photography Laboratory. History and development of photography as documentation and art; use of materials, techniques, laboratory, and studio practice. Open only to art majors. A fee of $25 will be charged, payable upon notification from the Bursar's Office at the beginning of the semester. Half-course. *van Dijk*

DEPARTMENTAL MAJOR

The student will elect a sequence of courses emphasizing either the history of art or design. The department offers work leading to graduation with distinction. See the section on honors in this *Bulletin*.

Major in History of Art

Prerequisites. Two courses from the sequence 61-66 of which at least one must be 61 or 62.

Major Requirements. Eight courses above the 60 level of which two must be at the 200 level. Majors must complete two years of college level study, or equivalent, of a foreign language. Students contemplating graduate study in art history are advised to acquire a reading knowledge of at least two foreign languages, one of which should be German.

Major in Design

Prerequisites. Introduction to art history, two courses from the sequence 61, 62, 63, 64, 65, 66. Art 53-54, two courses.

Major Requirements. Five studio courses exclusive of Art 53-54.

Studio Fees. A fee of $25 per semester is required in all design courses, including Art 119, to cover materials used in each course. The fee is payable upon notification from the Bursar's Office at the beginning of each semester.

Asian and African Languages

CHINESE

131, 132. Intensive Elementary Chinese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

HINDI-URDU

171, 172. Studies in Indian Literatures. Readings in translation. First semester: classical Indian literary traditions. Second semester: literatures from Indian languages, including novels, poetry, and drama, with special reference to European literary influences. Two courses. *Shonek*

181, 182. Intensive Elementary Hindi-Urdu. Four hours of classroom work, two hours of language drill. Concentration on the acquisition of conversational ability in Hindi-Urdu, with a grammar and vocabulary basic to both Hindi and Urdu. Introduction to the Devanagari script and the reading of graded texts. Two courses. *Shonek*

183, 184. Intensive Intermediate Hindi-Urdu. Four hours of classroom work, two hours of language drill. Advanced conversation in Hindi-Urdu reading and composition. Prerequisite: elementary Hindi-Urdu. Two courses. *Shonek*

185, 186. Advanced Hindi Reading and Composition. An introduction to

scholarly and literary Hindi prose and extensive practice in composition. Prerequisite: Hindi-Urdu 183, 184, or equivalent. Two courses. *Shonek*

200, 201. Special Studies in South Asian Languages. Intensive concentration in advanced Hindi reading and conversation, or specialized, graded work in cognate South Asian languages necessary for the advanced student contemplating field work in South Asia. Prerequisite: consent of instructor. Two courses. *Shonek*

JAPANESE

151, 152. Elementary Japanese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

153, 154. Intensive Intermediate Japanese. Four hours of classroom work, two hours of language drill. Two courses. *Rolf*

155, 156. Introduction to Modern Japanese Literature. Prerequisite: Japanese 153, 154 or equivalent. Two courses. *Rolf*

161. Modern Japanese Fiction in Translation. Readings of twentieth century Japanese novels and short stories. One course. *Rolf*

SWAHILI

101, 102. Elementary Swahili. Three hours of classroom work, plus language drill. Two courses. *Help*

Astronomy

For courses in Astronomy, see *Physics*.

Biology

11-12. Principles of Biology. A two-semester introduction to the discipline open only to freshmen and sophomores who have had no more than one year of biological science in high school. (Entering freshmen will be given first priority.) Lectures and laboratories. Two courses. *Staff*

11P, 12P. Preceptorials. Elective preceptorials for students enrolled in Biology 11, 12. *Staff*

14. Principles of Biology. A one-semester introduction to the discipline open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. (Offered in fall and spring terms.) One course. *Staff*

14P. Preceptorial. Elective preceptorial for students in Biology 14.

The above offerings, 11-12 and 14, may not both be taken for credit; either is an acceptable prerequisite for advanced courses. See other courses listed under *Botany and Zoology*.

Black Studies

Assistant Professor Burford, *Director;* Assistant Professor Olela; Visiting Professors Thorpe and Bambara; Visiting Lecturer Allen

Black studies is designed to provide instruction and study directed toward the particular experience of Black America and its concerns. Though intensive

work (a major) is worthwhile and encouraged, Black studies recognizes many of its course offerings as complementary to most students' primary fields of endeavor, as well as an essential component of a liberal arts education.

83, 84. Afro-American History. The Black experience in America from slavery to the present. (Also listed as History 145, 146.) Two courses. *Thorpe*

99. Dimension of Racism. The nature of racism, its interconnection with aspects and institutions of American life and its effects. One course. *Staff*

100. Philosophy of Black Liberation. One course. *Olela*

113. African Philosophy. Religious and political philosophy of twentieth century Africa. (Also listed as Religion 113.) One course. *Olela*

125. Religion and Theology of Black America. (Also listed as Religion 125.) One course. *Burford*

147. The Black in the City. (Also listed as Sociology 147.) One course.

150. Third World Literature. Selected works with special emphasis upon Black American, African, and Caribbean writers. One course. *Bambara*

151. Classic Literature of Black America. Works by Black authors of the Negro renaissance followed by Wright's *Native Son* and Ellison's *Invisible Man*. One course. *Staff*

152. Contemporary Literature of Black America. Essays, poetry, and fiction by contemporary Black writers. One course. *Jackson*

176, 177. Marxism and Black Liberation. Marxist perspective on the liberation of Black America. Two courses. *Olela*

189S. Special Topics. One course. *Olela*

191, 192. Independent Study. Two courses. *Staff*

193, 194. Independent Study in Community or Field Work. Two courses. *Staff*

195-196. Problems in Afro-American History. (Also listed as History 195V-196V.) Two courses. *Thorpe*

209, 210. Afro-American History. (Also listed as History 209, 210.) Two courses. *Thorpe*

THE MAJOR

Black Studies 99 and 100 are required for the major and strongly recommended as introductory to course work in Black studies. Black History 83, 84, 193, and 194 are required. (It is suggested that the student seek his own community assignment and request approval.) Three other courses above 100 are to be selected. One must be a seminar; and one may be 193 or 194, but not both.

Students majoring in Black studies will receive special counseling in planning their course of study and in considering their future vocation.

Botany

Professor Wilbur, *Chairman;* Professor White, *Director of Undergraduate Studies;* Professors Anderson, Billings, W. Culberson, Hellmers, Johnson, Naylor, Philpott, and Stone; Associate Professors Antonovics, Barber, Boynton,

Knoerr, Searles, and Strain; Assistant Professors Blankley and Christensen; Lecturer C. Culberson

See *Biology* for a listing of introductory courses.

The *L* suffix on a course number indicates that the course includes a laboratory. Note that in some courses the laboratory is optional, and a student may register for these courses with (e.g., Botany 135L) or without (e.g., Botany 135) the laboratory.

51L. Culture and Propagation of Plants. Principles of physiology, genetics, ecology, and taxonomy as applied to horticulture. Lectures, greenhouse and garden work, and field trips. Prerequisite: introductory college biology. One course. *Philpott*

53. Introductory Oceanography. Basic principles of physical, chemical, biological, and geological oceanography. Prerequisite: one course in a laboratory science. (Also listed as Geology 53.) One course. *Searles and Pilkey*

63. Ecology and Man. Principles of populations, communities, and ecosystems with applications to human society. One course. *Christensen or Strain*

90. Plants and Man. The co-evolution of agriculture and civilization; man's invention of elite races of domesticated plants from wild species by artificial selection. The economic botany of the world's major crops. One course. *Culberson or Wilbur*

103L. General Bacteriology. A study of the morphology and fundamental physiological processes of bacteria: their relationship to sanitation, public health, soil fertility, and food preservation. Prerequisite: introductory biology. One course. *Johnson*

105L. Plant Diversity. Major groups of the living plants, their evolutionary origins and phylogenetic relationships. Prerequisite: introductory biology. One course. *Culberson and White*

135. Evolutionary Systematics. Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186, and Zoology 286. Prerequisite: college biology. (Also listed as Zoology 135 and Zoology 235.) One course. *Bailey (Zoology), Lundberg (Zoology), and Stone*

135L. Evolutionary Systematics. Same course as 135 with laboratory included. One course. *Bailey (Zoology), Lundberg (Zoology), and Stone*

151L. Introductory Plant Physiology. The principal physiological processes of plants, including water relations, mineral nutrition, synthesis and use of foods, and growth phenomena. Prerequisites: introductory college biology and one year of chemistry; organic chemistry is desirable. One course. *Naylor*

152L. Plant Identification. Practice in the identification of local plants and a study of the principles underlying plant classification. Laboratory, lectures, and field trips. One course. *Wilbur*

155L. Plant Anatomy. A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or permission of instructor. One course. *White*

156L. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisites: introductory biology and one other course in biology. One course. *Billings, Christensen, or Strain*

167L. Plant Community Ecology. Concepts and methods of plant synecology. Introduction to the plant communities of North Carolina. Prerequisites: Botany 152 and 156 or equivalent and permission of the instructor. One course. *Christensen*

169. The Marine Environment. (For description see Marine Sciences.)

180. Principles of Genetics. Structure and properties of genes and chromosomes, and evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equivalent. (Also listed as Botany 280, Zoology 180, and Zoology 280.) With or without laboratory. One course. *Antonovics, Boynton, and Gillham (Zoology)*

180L. Principles of Genetics. Same course as 180 with laboratory included. One course. *Antonovics, Boynton, and Gillham (Zoology)*

186. Evolutionary Mechanisms. Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135 and Zoology 235. Prerequisite: college biology. (Also listed as Zoology 186.) One course. *Antonovics and H. Wilbur (Zoology)*

191T, 192T, 193T, 194T. Independent Study. Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*

195S, 196S. Seminar in Botany. Credits to be arranged. *Staff*

202L. Phytoplankton Systematics. Taxonomy and classification of marine phytoplankton; general characteristics, phytogeography, life histories, and study techniques. Individual projects. (Given at Beaufort.) One and one-half courses. *Blankley*

203. Cytogenetics. Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variations, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. One course. *Anderson*

203L. Cytogenetics. Same course as 203 with a laboratory. One course. *Anderson*

204L. Marine Microbiology. The major groups of marine microorganisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in introductory biology or botany. (Given at Beaufort.) One and one-half courses. *Blankley*

206L. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations, and for study of micro and ultrastructures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. (Also listed as Forestry 206.) Prerequisite: college botany or biology. One course. *Philpott*

209L. Lichenology. Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. One course. *Culberson*

210L. Bryology. Morphological, systematic, and ecological characteristics of mosses and liverworts. One course. *Anderson*

212L. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. One course. *Searles*

214L. Biological Oceanography. See Zoology 214. (Given at Beaufort.) One and one-half courses. *Barber*

221L. Mycology. Field and laboratory study of vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in local flora. Prerequisite: one year of biological science. One course. *Johnson*

225ST, 226ST. Special Problems. Students with adequate training may do special work in the following fields:

1. Cytology; Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Blankley*
5. Genetics. *Boynton*
6. Ecology. *Christensen*
7. Lichenology. *Culberson*
8. Physiology. *Hellmers*
9. Bacteriology; Mycology. *Johnson*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics of Flowering Plants. *Stone*
14. Ecology. *Strain*
15. Anatomy and Morphology of Vascular Plants. *White*
16. Systematics and Taxonomy of Vascular Plants. *Wilbur*

233L. Microbiology. Introduction to bacteriology, virology, cell biology, and immunology. Structure, metabolism, and growth of bacteria; the properties of bacterial and animal viruses; and basic immunology. (Also listed as Microbiology 233.) One course. *Willet, Burns, Joklik, and Amos*

236S. Major Global Ecosystems. A study of a single global ecosystem such as arctic-alpine, desert, tropical rainforest, grassland, or coniferous forest, including the place and effects of both primitive and modern man. One course. *Billings*

248. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, nucleic acids, and the metabolic interrelationships of these compounds. The biochemical basis of photosynthesis, genetics, vision, nutrition, nerve conduction, and muscle contraction will also be considered. Prerequisites: organic chemistry (second semester may be concurrent), college physics and mathematics, or permission of instructor. (Also listed as Biochemistry 248 and Zoology 248.) One course. *Sage*

250L,S. Plant Biosystematics. Descriptive and experimental procedures used to assess systematic implications of vascular plant evolution. Laboratory, discussion, and field oriented problems. Prerequisites: basic courses in systematics and genetics. One course. *Stone*

252L. Plant Metabolism. The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. One course. *Naylor*

256. Physiological Role of Minerals and Water. Availability, uptake, transport, and function of minerals and water in plant growth. Prerequisite: Botany 151 or equivalent. One course. *Hellmers*

257S. Principles of Plant Distribution. Interpretation of floristic and ecological plant geography. Prerequisite: Botany 156 or equivalent. One course. *Billings*

258. Physiology of Growth and Development. Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. One course. *Naylor*

259. The Environment. Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 156 or equivalent. One course. *Billings*

265L. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 151 and 156 or equivalent. One course. *Strain*

268L,S. Quantitative Plant Ecology. Experimental design, statistics, and analysis of pattern, population growth, diversity, community composition, and ecosystem dynamics. Prerequisites: statistics and Botany 156 or equivalent and permission of the instructor. One course. *Christensen*

285S. Population Genetics. A seminar and lecture course devoted to the analysis of the current literature in population genetics. Prerequisites: genetics or Botany 280 or equivalent and consent of the instructor. One course. *Antonovics*

287S. Quantitative Genetics. Analysis of genetic variation in continuous traits. Models of continuous variation; genetic, environmental, and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: Botany 180 or equivalent and permission of instructor. One course. *Antonovics*

295S, 296S. Seminar. Credits to be arranged. *Staff*

MARINE LABORATORY

Botany 202, 204, 211 (Marine Phycology), and 214 are offered during the summer at the Duke University Marine Laboratory, Beaufort, N.C. The Department of Botany also participates in the spring term program at the Marine Laboratory. Consult the *Bulletin of the Marine Laboratory* for further information.

THE UNIVERSITY PROGRAM IN GENETICS

Courses offered by the Botany Department are an integral part of this interdepartmental program. Refer to the announcement in this *Bulletin* under *Genetics, the University Program* for descriptions of the other offerings.

DEPARTMENTAL MAJOR

For the A.B. Degree

Prerequisites. Introductory college biology or advanced placement in botany; two semesters of introductory chemistry (Chemistry 11-12 recommended) or advanced placement in chemistry; one semester of college mathematics or equivalent.

Major Requirements. A minimum of 8 approved science courses in addition to prerequisites; at least 5 courses to be selected from the following: Botany 105L (Plant Diversity), 151L (Plant Physiology), 135L (Evolutionary Systematics) or 152L (Plant Identification), 155L (Plant Anatomy), 156L (Plant Ecology) and 180 (Genetics). With the approval of the director of undergraduate studies, one or two of the remaining science courses may be taken in a related department. A student's program will be tailored to his interests and plans for the future.

For the B.S. Degree

Prerequisites. Introductory college biology or advanced placement in botany; chemistry through organic; two terms of college mathematics or equivalent.

Major Requirements. Eight science courses as described under major requirements for the A.B. degree. A proficiency in reading German or Russian or two years of college German or Russian. One year of college physics or equivalent and a course in statistics are recommended. The emphasis in this preprofessional program will depend on the student's interests, and each program will be arranged on an individual basis.

Interdepartmental Concentration

By consent of the appropriate departments, an interdepartmental program (e.g., in cell and molecular biology, physical biology, marine biology etc.) may be pursued instead of a departmental major. The appropriate director of undergraduate studies will arrange administrative responsibility for reasonable interdepartmental programs.

Canadian Studies Program

Professor Preston, *Director and Chairman of the Canadian Studies Committee*

The program of Canadian studies is designed to provide the student with an understanding of Canada and its problems and prospects. In the Canadian Studies Program, completion of which is imprinted on the official record upon graduation, a student must take 4 courses with Canadian content or the equivalent thereof (see below). These must include the Interdisciplinary Course, Canada: Problems and Issues of an Advanced Industrial Society, in which members of the Departments of History, Political Science, Economics, Sociology, and Romance Languages, and visiting Canadian specialists participate. It is recommended that students who do not have the equivalent of two years of college-level French should take French 181-182, Intensive French.

The program in Canadian studies may be taken as part of a major in history or political science, as a supplement to any other major, as part of an interdepartmental concentration, or under Program II. For a description of the courses consult listings under Interdisciplinary Courses and the specified departments.

Courses with Full Canadian Content. The following courses count as 1 full course in the 4 required for the Canadian studies option:

Economics 116S. Economic Geography of Anglo-America. *Tuthill*

English 167. Canadian Literature in English. *Armitage*

French 125. The French of Canada. *Hull*

History 183. Canada from the French Settlement. *Preston*

Interdisciplinary Course 184. Canada: Problems and Issues of an Advanced Industrial State. *Preston, Canadian Studies Committee Member, and Visiting Lecturers*

Political Science 195. Canadian Political Behavior. *Kornberg*

Courses with a Significant Canadian Content. Two of these will count as 1 course toward the 4 courses required for the Canadian studies option:

Anthropology 164. Peasantry and Peasant Movements. *Fox*

Anthropology 280S. Ethnicity and Acculturation. *Fox*

Economics 201S.6. Current Problems in International Monetary Arrangements. *Tower*

Economics 265S. International Trade and Finance. *Bronfenbrenner or Tower*

History 178. Diplomacy of the United States. *Davis*

History 297. The British Empire in the Nineteenth Century. *Preston*

History 298. Commonwealth in the Twentieth Century. *Preston*

Law 230. International Law. *Grzybowski*

Political Science 135. Comparative Legislative Behavior. *Mishler*

Political Science 200B. Senior Seminar in Comparative Government and Politics. *Cole*

Political Science 275. American Party System. *Kornberg*

Political Science 293. Federalism. *Leach*

Sociology 142. Sociology of Mass Communication. *Smith*

Sociology 145. Urban Sociology. *Smith*

Information about other courses which would enrich a program in Canadian studies may be obtained from the Director of Canadian Studies. A limited amount of financial aid for field work in Canada is available for undergraduates in the Canadian Studies Program.

Chemistry

Professor Quin, *Chairman;* Professor Wells, *Director of Undergraduate Studies;* Professor Bonk, *Supervisor of Freshman Instruction;* Professors Bradsher, Chesnut, Hobbs, Jeffs, Krigbaum, McPhail, Parham, Poirier, Smith, Strobel, and Wilder; Associate Professors Henkens, Lochmüller, Palmer, and Porter; Assistant Professors Baier, Baldwin, Crumbliss, and Gutknecht

1, 2. General Chemistry. For students not intending to pursue additional courses in chemistry. Students intending to take additional courses in chemistry must take Chemistry 11-12. Chemistry 1, consisting of three lectures and one discussion class, emphasizes the principles of chemistry; Chemistry 2, consisting of two lectures, one recitation, and one three hour laboratory, emphasizes organic and biochemistry. Prerequisite: two years of high school mathematics. Chemistry 1 or its equivalent is a prerequisite for Chemistry 2. Two courses. *Crumbliss and Porter*

11, 12. Principles of Chemistry. A rigorous introductory course for students who intend to take additional courses in the department. Credit cannot be received for both sequences 1-2 and 11-12. Chemistry 11 emphasizes stoi-

chiometry and atomic and molecular structure. Chemistry 12 emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Laboratory work includes both qualitative and quantitative analysis. Two lectures, one recitation and one four hour laboratory. Prerequisites: one year of high school chemistry and qualification for Mathematics 31. Two courses. *Bonk and Staff*

117. Inorganic Chemistry. Bonding, structures, and reactions of inorganic compounds studied through physical chemical concepts. Three lectures. Prerequisite: Chemistry 161. One course. *Crumbliss, Palmer, or Wells*

132. Quantitative and Instrumental Analysis. Practice in advanced quantitative analysis and in the use of chemical instrumentation. Theoretical and applied aspects of chemical and instrumental methods. Three lectures and four and one-half laboratory hours. Prerequisite: Chemistry 161. One course. *Gutknecht, Lochmüller, or Strobel*

151, 152. Organic Chemistry. The structures and reactions of the compounds of carbon. First semester laboratory: techniques of separation and structure determination. Second semester: organic reactions and preparations. Three lectures and four laboratory hours. Prerequisite: Chemistry 12 or the permission of the Director of Undergraduate Studies. Chemistry 151 is a prerequisite for 152. Two courses. *Baldwin, Bradsher, Jeffs, Parham, Porter, Quin, and Wilder*

152P. Preceptorial. Elective preceptorial for students in Chemistry 152. *Staff*

155. Spectral and Structural Study of Organic Compounds. Advanced study of spectral properties and structural aspects of organic compounds and the influence of structure on reactivity. Laboratory work emphasizes the systematic identification of compounds by their spectral aspects and by their chemical properties. Three lectures and four and one-half laboratory hours. Prerequisite: Chemistry 152. One course. *Quin and Porter*

161, 162. Physical Chemistry. Fundamentals of theoretical chemistry illustrated by selected laboratory experiments. Two lectures, one recitation, and four laboratory hours. Prerequisites for 161: Chemistry 152, Physics 51, 52, and Mathematics 32. Prerequisites for 162: Chemistry 161 and either Mathematics 103 or permission of the instructor. Two courses. *Chesnut, Henkens, Hobbs, Krigbaum, McPhail, Poirier, and Smith*

191, 192. Independent Study. Supervised reading and research. Open to students by permission of the department. Two courses. *Staff*

193, 194. Independent Study. Supervised reading and research. Open to students who have completed Chemistry 191, 192, and by permission of the department. Two courses. *Staff*

195S. Seminar. Organic chemistry of natural products. Open to senior chemistry majors, and by permission of the department. One course. *Staff*

196S. Seminar. Selected topics in physical chemistry of biological macromolecules. Open to senior chemistry majors, and by permission of the department. One course. *Henkens*

201. Molecular Spectroscopy. Selected spectroscopic methods in the study of molecular structure. Symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra; examples from both inorganic and organic chemistry. Three lectures. Prerequisite: permission of the department. One course. *Staff*

203. Quantum Chemistry. Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundation of quantum theory. Emphasis on the application of molecular orbital theory to organic and inorganic systems. Three lectures. Prerequisite: permission of the department. One course. *Staff*

205. Structure and Reaction Dynamics. Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Emphasis on the use of kinetic techniques to solve problems in reaction mechanisms. Three lectures. Prerequisite: permission of the department. One course. *Staff*

207. Principles of Thermodynamics, Diffraction, and Kinetics. Three lectures. Prerequisite: permission of the department. One course. *Staff*

230. Chemical Pollution of Coastal Waters. Sources and sinks for chemical pollutants and impact on coastal biomes. Laboratory and field experiments to illustrate problems in verifying the extent of chemical pollution. Analysis of exemplary chemical plants to derive plans for pollution control. Prerequisites: Chemistry 161, 162, or equivalent, Chemistry 132, or equivalent, calculus, or permission of the instructor. (Given at Beaufort.) One and one-half courses. *Baier*

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Prerequisites: a year of physical chemistry (Chemistry 161, 162, or equivalent); statistics (Mathematics 183, or equivalent), or permission of the instructor. Lectures, laboratory work, and field trips. (Given at Beaufort.) One and one-half courses. *Baier*

275, 276. Advanced Studies. (1) Analytical chemistry; (2) inorganic chemistry; (3) organic chemistry; and (4) physical chemistry. Open to especially well prepared undergraduates by permission of the department. One course each section. *Staff*

DEPARTMENTAL MAJOR

For the A.B. Degree

Prerequisites. Chemistry 11 and 12 or advanced placement; Mathematics 31, 32; Physics 51, 52.

Major Requirements. Chemistry 132, 151, 152, 161, and 195S-196S. Possible alternatives to 195S-196S are:

1. Students may specifically request Chemistry 191-192, provided they pursue an enriched program in the area of their proposed research. An enriched program would include at least one chemistry course at the 200-level or Chemistry 117 or Chemistry 155 or Chemistry 162. The permission of the proposed research director and the independent study coordinator would be required.
2. Students may pursue their two courses of independent study or seminar outside the department in a biological or physical science, and in this case they would be required to complete the major by taking one additional chemistry course at the 200-level or Chemistry 117 or Chemistry 155 or Chemistry 162.

Recommended. Computer Science 51; Mathematics 103; two semesters of a foreign language or the equivalent.

For the B.S. Degree

Prerequisites. Chemistry 11 and 12 or advanced placement; Mathematics 31, 32, 103; Physics 51, 52; two semesters of German or Russian, or the equivalent.

Major Requirements. Chemistry 117, 132, 151, 152, 155, 161, 162, 191-192, and 203 or 207. Bachelor of Science majors in interdisciplinary or double major programs may elect independent study in one of their fields.

Recommended. Physics 161; Mathematics 104; Computer Science 51.

Students planning graduate study in chemistry should complete one college year (or its equivalent) of a second language usually chosen from one of the above or French, and take additional courses in mathematics and physical sciences (see departmental adviser).

Classical Studies

Professor Oates, *Chairman;* Assistant Professor Rigsby, *Director of Undergraduate Studies;* Professors Newton, Richardson, and Willis; Associate Professor Stanley; Assistant Professors Burian and Younger; Visiting Lecturer Levy

GREEK

1-2. Elementary Greek. A study of grammar and an introduction to reading. Two courses. *Willis*

63-64. Intermediate Greek. Introduction to Greek prose and poetry. First semester: Plato's *Apology of Socrates* and two dialogues. Second semester: two plays of Euripides. Two courses. *Staff*

87, 88. Sight Reading in Greek Prose. Readings from easy Attic prose writers. Open to students who have completed one year of college Greek, or the equivalent, with consent of the instructor. Two hours per week throughout the year. Two half-courses. *Willis*

105S. Seminar in Greek: Homer. One course. *Stanley*

106S. Seminar in Greek: The Lyric Poets. One course. *Stanley*

107S. Seminar in Greek: Tragedy. One course. *Burian*

108S. Seminar in Greek: Comedy. One course. *Burian*

109S. Seminar in Greek: The Historians. One course. *Rigsby*

110S. Seminar in Greek: The Orators. One course. *Burian*

117. Greek Prose Composition. The character of the course is determined by the needs of the students enrolled. Half-course. *Willis*

181S, 182S. Greek Seminar. An intensive introduction to the language and literature. Meets five times a week. Open only to students who have achieved proficiency in another language. Two courses each. *Staff*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors and seniors. Two courses. *Staff*

193, 194. Directed Research in Greek. Research culminating in the writing of one longer or two shorter papers as partial fulfillment of the requirements for graduation with distinction. Open only to senior majors. Two courses. *Staff*

198S, 199S. Senior Seminar in Greek. The seminar will change according to the interests of the instructor. Two courses. *Staff*

For Seniors and Graduates

200. Graduate Reading. Open to qualified undergraduates by permission of the instructor. One course. *Staff*

203. Homer. The *Iliad* and *Odyssey*; the problems of language and structure in the epic; present state of Homeric scholarship. One course. *Levy*

205. Greek Lyric Poets. Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. One course. *Burian*

206. Aeschylus. The *Oresteia*, with study of the form of *Agamemnon* and its place in the design of the trilogy. One course. *Willis*

208. Sophocles. The Theban plays; the structure and style of Sophoclean tragedy. One course. *Stanley*

209. Euripides. Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. One course. *Stanley*

210. Aristophanes. Origin and development of Greek comedy; representative plays of Aristophanes. One course. *Burian*

221. Early Greek Prose. Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus; Gorgias, Antiphon, and the Old Oligarch. One course. *Willis*

222. Thucydides. The *History*; Thucydides' historical method and style. One course. *Willis*

223. Greek Orators I. Early fourth century rhetoric, including Andocides, Lysias, and Isocrates. One course. *Staff*

224. Greek Orators II. Aeschines' *Against Ctesiphon* and Demosthenes' *On the Crown* in the light of fourth century political history and rhetorical development. One course. *Willis*

225. Plato. Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. One course. *Stanley*

231. Hellenistic Poetry. The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. One course. *Stanley*

241. Advanced Prose Composition. Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. Half-course. *Willis*

LATIN

1-2. Elementary Latin. Study of the structure of the language (inflexions, vocabulary, syntax, and pronunciation). Second semester: reading in prose and poetry. Two courses. *Staff*

63. Intermediate Latin. Selected prose. One course. *Staff*

64. Intermediate Latin: Vergil. Readings from the *Aeneid*; lectures on the epic and its history and Vergil's style and technique. One course. *Staff*

87, 88. Sight Reading in Classical, Mediaeval, and Renaissance Latin. Offered especially for students in fields other than classical studies who wish to

maintain and refresh their Latin. Two hours per week throughout the year. (Open to students enrolled in other courses in Latin only on the recommendation of their instructors.) Two half-courses. *Staff*

100. Not a course. This number represents one course credit for advanced placement which will be awarded for scores of 4 or 5 on one or more of the College Board Advanced Placement tests in Latin. One course credit may be earned by a score of 3 if the student successfully completes one further semester of Latin.

105S. Seminar in Latin: Ovid. One course. *Newton*

106S. Seminar in Latin: Lucretius. One course. *Richardson*

107S. Seminar in Latin: Lyric and Elegiac Poets. One course. *Richardson*

108S. Seminar in Latin: The Historians. One course. *Staff*

109S. Seminar in Latin: Comedy. One course. *Richardson*

110S. Seminar in Latin: The Novel. One course. *Richardson*

117. Latin Prose Composition. The course content is determined by the needs of the students enrolled. One course. *Staff*

181S, 182S. Latin Seminar. An intensive introduction to the language and literature. Meets five times a week. Open only to students who have achieved proficiency in another language. Two courses each. *Staff*

191, 192. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. Two courses. *Staff*

193, 194. Directed Research in Latin. Research culminating in the writing of one longer or two shorter papers as partial fulfillment of the requirements for graduation with distinction. Open only to senior majors. Two courses. *Staff*

198S, 199S. Senior Seminar in Latin. The seminar will change according to the interests of the instructor. Two courses. *Staff*

For Seniors and Graduates

200. Graduate Reading. Open to qualified undergraduates by permission of the instructor. One course. *Stanley*

201. The Verse Treatise. The genre of didactic poetry; emphasis on Lucretius' *De Rerum Natura*, Vergil's *Georgics*, and Ovid's *Ars Amatoria*; attention to Cicero's *Aratea*, the *Astronomica* of Manilius, Horace's *Ars Poetica*, and Ovid's *Fasti*. One course. *Richardson*

202. Roman Satire. A survey of the genre with concentration on Horace, Juvenal, and Persius. One course. *Staff*

203. Epic: Vergil. The *Aeneid*. One course. *Staff*

204. Epic: Lucan and Statius. The development of the Roman epic in the Silver Age. One course. *Staff*

207. The Prose Epistle. The letter as a vehicle of communication and as a literary form. One course. *Richardson*

208. The Epistle in Verse. The letter as a literary form; reading in the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. One course. *Staff*

209. Fragments of Early Latin. The remains of Latin poetry of the third and second centuries B.C., from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. One course. *Stanley*

210. Lyric and Occasional Poetry. Shorter verse forms: epigram, pastoral, song, and panegyric. One course. *Staff*

211. Roman Oratory I. The literary history and criticism of Roman oratory. One course. *Richardson*

212. Roman Oratory II. A continuation of Latin 211. One course. *Staff*

221. Mediaeval Latin I. Latin literature of late antiquity, from Prudentius to the Carolingian Revival. One course. *Newton*

222. Mediaeval Latin II. Literature in Latin from Charlemagne to the Renaissance. One course. *Newton*

225. Latin Palaeography. Latin book hands from the Roman Empire to the Italian Renaissance. One course. *Newton*

241. Advanced Latin Composition. Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. Half-course. *Richardson*

250. Teaching Latin. Objectives, methods, and problems; the study of textbooks, programs, and related materials. One course. *Staff*

CLASSICAL STUDIES

11D. Greek Civilization. The culture of the ancient Greeks from the Bronze Age to Alexander the Great: art, literature, history, philosophy, and religion. One course. *Staff*

12D. Roman Civilization. The culture of the ancient Romans from their beginnings to Constantine: art, literature, history, philosophy, and religion. One course. *Staff*

51. Greek Literature in English Translation. Reading in translation of major Greek authors, with emphasis on the Homeric epic and the Attic drama. One course. *Burian and Rigsby*

52. Latin Literature in English Translation. Reading in translation of major Roman authors, such as Plautus, Terence, Vergil, Horace, Ovid, Petronius, Juvenal, Tacitus, and Apuleius. One course. *Burian and Rigsby*

53. Greek History. The political and intellectual history of the Hellenes from earliest times to the death of Alexander the Great. (Also listed as History 53.) One course. *Rigsby*

54. Roman History. The Roman Republic and Empire to the Council of Nicaea. (Also listed as History 54.) One course. *Rigsby*

55. Greek Art and Archaeology. Greek architecture, sculpture, and painting from the Bronze Age to the classical period. Study of objects in the Duke Classical Collection is included. One course. *Younger*

56. Roman Art and Archaeology. Rome's achievement in architecture and decoration, portraiture, and relief sculpture; from the Villanovans to the Antonine emperors. One course. *Younger*

57S, 58S. Seminar in Classical Studies. Aspects of the history, art, and literature of classical Greece and Rome. For freshmen and sophomores. Two courses. *Rigsby*

114. Greek Drama. Reading in English translation of Aeschylus, Sophocles, Euripides, Aristophanes, and Menander. One course. *Burian and Rigsby*

115. The Classical Tradition. The notion of the "classical" from the creation of the archetype to the present. (Also listed as Comparative Literature 115.) One course. *Burian and Rigsby*

117. Ancient Mythographers. Myth in classical and mediaeval writers from Hesiod to Boccaccio. (Also listed as Comparative Literature 117.) One course. *Newton*

134. The Athenian Empire. Imperial democracy at Athens and its consequences for the *polis*. (Also listed as History 125.) One course. *Oates*

135. Alexander the Great. His career and the effects of his conquests. (Also listed as History 126.) One course. *Oates*

136. The Hellenistic Kingdoms. The Greek world from the death of Alexander in 323 B.C. to the end of the second century B.C. One course. *Oates*

137. The Roman Revolution. Rome from the time of the Gracchi (133 B.C.) to the death of Augustus (14A.D.). One course. *Oates*

138. The Decline and Fall of Rome. Rome from the death of Commodus to the accession of Constantine. One course. *Oates*

143. The Ancient Cities of Greece. The *polis* as a physical and societal complex; urban problems and their solutions through the centuries. A different Greek city that has been extensively excavated and well published is chosen as representative of each century and examined in detail. One course. *Richardson*

144. Ancient Cities: Rome and Her Colonies. As a metropolis and a cosmopolis; the sources and uses of significant architectural and urbanistic ideas; the city government and organization of the megalopolis; Roman colonies throughout the Empire. One course. *Richardson*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors and seniors. Two courses. *Staff*

193, 194. Directed Research in Classical Studies. Research culminating in the writing of one longer or two shorter papers as partial fulfillment of the requirements for graduation with distinction. Open only to senior majors. Two courses. *Staff*

195S, 196S. Junior Seminar in Classical Studies. The seminar will change each year according to the interest of the instructor. Two courses. *Staff*

For Seniors and Graduates

231. Greek Sculpture. Techniques and style of the major schools and personalities in archaic, classical, and Hellenistic free-standing and architectural sculpture. One course. *Stanley*

232. Greek Painting. Techniques and style in the various media; emphasis on the problems of chronology, attribution, and iconography of Attic pottery. One course. *Stanley*

235. Roman Architecture. Significant monuments chosen to exemplify the Roman genius in building in the late Republic and early empire. One course. *Richardson*

236. Roman Painting. Roman pictorial art with concentration on the wallpainting from Campania. Investigation of techniques, iconography, and use of pictures in decoration. One course. *Richardson*

253. Greece to the Orientalizing Period. One course. *Oates*

254. The Age of the Tyrants and the Persian Wars. One course. *Oates*

255. The Age of Pericles. One course. *Oates*

256. The Fourth Century through Alexander. One course. *Oates*

260. The History of Rome to 164 B.C. One course.

261. The Roman Revolution, 146-30 B.C. One course. *Oates*

262. Rome under the Julio-Claudians. One course. *Staff*

263. From the Flavian Dynasty to the Severan. One course. *Staff*

264. From Septimius Severus to Constantine. One course. *Staff*

270. The Rise of the Hellenistic Kingdoms. One course. *Oates*

271. The Hellenistic World, 250-31 B.C. One course. *Oates*

DEPARTMENTAL MAJOR IN GREEK

Prerequisite. Greek 2 or equivalent.

Major Requirements. Six courses in Greek above the level of Greek 2. In addition, students will be required to pass an examination testing proficiency in Greek composition or to complete Greek 117.

Related Work. Greek majors normally take at least four semesters of Latin, and are also encouraged to take course work in ancient history and/or archaeology. The nature and amount of related work, however, may vary with the student.

DEPARTMENTAL MAJOR IN LATIN

Prerequisite. Latin 64 or equivalent.

Major Requirements. Six courses in Latin above the level of Latin 64. In addition, students will be required to pass an examination testing proficiency in Latin composition or to complete Latin 117.

Related Work. Latin majors normally take at least four semesters of Greek, and are also encouraged to take course work in ancient history and/or archaeology. The nature and amount of related work, however, may vary with the student.

DEPARTMENTAL MAJOR IN CLASSICAL STUDIES (ANCIENT HISTORY AND ARCHAEOLOGY)

Prerequisites. Classical Studies 11D-12D, 51-52, 53-54, 55-56, or 57S-58S.

Major Requirements. Eight courses at the 100-level or above, including two courses of seminar or independent study, or a combination of these. Reading knowledge of Latin or Greek to the level of Latin 64 or Greek 64. Two courses in the ancient languages above that level may be counted toward the major.

Majors in either Greek or Latin who contemplate graduate work are reminded of the necessity for competence in both languages for all higher degrees and of the requirement for a reading knowledge of French and German.

Majors are eligible for nomination to a term of one semester during their junior year at the Intercollegiate Center for Classical Studies in Rome, of which

Duke University is a founding member, at a cost comparable to that of a semester at Duke. Financial arrangements are made through the University, and students may apply for scholarship assistance. Courses in Greek, Latin, ancient history, and archaeology taken at the Center are counted toward the major requirements. For further information, see section on study abroad.

The department offers work leading to graduation with distinction. See the section on Honors in this *Bulletin*.

Comparative Area Studies: Africa, Asia, Latin America, and Russia

Associate Professor O'Barr (Anthropology), *Director;* Professors Bonfenbrenner (Economics), Silberman (History), TePaske (History), Tiryakian (Sociology), and Treml (Economics); Associate Professors Di Bona (Education), Hartwig (History), and Johns (Political Science); Assistant Professors Corless (Religion), Dirlik (History), and Valenzuela (Political Science)

The aim of the comparative area studies major is to introduce the student to the problems of contemporary societies outside of Western Europe and North America through a study of interactions between traditional features of the societies and the forces of social and political change. Special attention is given to institutional characteristics of the differing societies. The great diversity of traditional institutions in the different societies that form the basis for the major provides opportunities for examination of intellectual, political, economic, religious, and social movements primarily in the areas of Africa, Asia, Latin America, and Russia. The major is under the supervision of a committee consisting of faculty members from departments with relevant area interests.

THE MAJOR

The student must identify his primary disciplinary interest and his geographic area of interest. This will normally be done at the end of the sophomore year, but if fulfillment of requirements is possible, it may be done at a later stage. Students should consult the Director before declaring a major because of the program's complexity.

A special feature of the major is the provision for the granting of credit to students who wish, and who are qualified, to study abroad in the area of choice or who undertake intensive summer language programs in the United States.

For a description of the following courses consult the listings under the specified department.

Prerequisites. Any two of the following courses: History 175D, 176D; Anthropology 94 or 99; Religion 57. Four semester-courses in the language of the area of concentration, two of which may be a continuation of the language, or two of the following: literature of the area in translation or general linguistics. Students identifying Africa as their area of interest may offer a relevant European language (other than English) in place of an African language. The language-literature prerequisite need not be completed before the declaration of the major.

Major Requirements. Four semester-courses in the geographic area of interest (the area of the language studied). Two semester-courses in a second geographic area included in the major; senior seminar in comparative area studies.

The following area courses currently available for the fulfillment of the major prerequisites and requirements are:

LANGUAGE AND LITERATURE

Anthropology 107, 259, 260, 261.
Black Studies 113, 150, 189.
Chinese 131-132.
English 107.
German 219.
Hindi-Urdu 171-172, 181-182, 183-184, 185-186, 200-201.
Japanese 151, 152, 153, 154, 155, 156, 161.
Portuguese 181, 185, 186.
Slavic 1-2, 63-64, 105, 119, 120, 124, 179, 185, 191, 192, 193, 194, 201, 202, 207, 212S, 213, 214, 225S, 227, 230, 232.
Swahili 101, 102.

AREA COURSES

Anthropology 124, 125, 134, 164, 193, 220, 222.
Art 149, 150, 191T, 192T, 193T, 194T.
Black Studies 189.
Economics 114, 120, 191, 192, 193, 194, 214, 219, 293, 294S.
Education 202, 218, 219.
History 115, 116, 117, 118, 119, 120, 128, 131, 141, 142, 143, 147, 148, 152, 155, 156, 161, 162, 177, 201-202, 231-232, 240, 241-242, 247, 248, 255S-256S, 261-262, 265-266, 287-288, 297-298, 191, 192, 193, 194, 195G-196G, 195J-196J, 195S-196S, 195T-196T, 195W-196W, 195X-196X, 195Y-196Y.
Political Science 117, 120, 122, 135, 151, 152S, 155, 161S, 165S, 166S, 180, 181, 182S, 235, 250, 253, 271, 280, 191, 192, 193, 194.
Religion 71S, 113, 140, 141, 142, 143, 149, 217, 218, 283, 285, 286, 287, 288, 289, 191, 192, 193, 194.
Sociology 136, 251, 255, 259.
Interdisciplinary 101, 102.

Comparative Literature

Professor Salinger (German), *Chairman of the Committee on Comparative Literature;* Professors Anderson (English), Fowlie (Romance Languages), Lievsay (English), Newton (Classical Studies), Reiss (English), Tetel (Romance Languages), and Wardropper (Romance Languages); Associate Professors Clubbe (English), Harwell (English), Jezierski (Slavic Languages), Krynski (Slavic Languages), and Reardon (English); Assistant Professor Burian (Classical Studies); Assistant Professor Shonek (Hindi-Urdu)

100. Introduction to Comparative Literature. History, prevailing approaches, methods of investigation, problems of literary influence and translation; European and American movements and genres. Occasional guest lecturers. One course. *Staff*

112. English Literature of the Middle Ages. (Also listed as English 112.) One course. *Reiss*

115. The Classical Tradition. (Also listed as Classical Studies 115.) One course. *Burian and Rigsby*

117. Ancient Mythographers. (Also listed as Classical Studies 117.) One course. *Newton*

124. Continental Humanism. (Also listed as Romance Languages 124.) One course. *Tetel*

151. Theory and Form of Tragedy. (Also listed as French 151.) One course. *Fowlie*

160. An Approach to Comedy. (Also listed as Spanish 160.) One course. *Wardropper*

161, 162. The European Background of English Literature. (Also listed as English 161, 162.) Two courses. *Harwell*

164. Readings in European Literature. (Also listed as English 164.) One course. *Clubbe*

165. Readings in Scandinavian Literature. (Also listed as English 165.) One course. *Anderson*

169. Modern European Drama. (Also listed as English 169.) One course. *Reardon*

171, 172. Studies in Indian Literatures. (Also listed as Hindi-Urdu 171, 172.) Two courses. *Shonek*

186. Non-Russian Slavic Literatures. (Also listed as Slavic Languages and Literatures 186.) One course. *Jezierski*

191, 192. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission. Two courses. *Salinger*

193, 194. Independent Study. Directed readings and research. Open only to qualified students in the senior year, by permission. Two courses. *Salinger*

201, 202. Romanticism. Studies in the origin, rise, and development of the Romantic Movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany, with some reference to other countries. Selected subjects will occasionally be covered by speakers from various departments of the University. Two courses. *Salinger*

203, 204. Realism and Symbolism. Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. Two courses. *Salinger*

205. Foundations of Twentieth Century European Literature. The roots of the contemporary scene (Proust, Mann, Rilke, Kafka, Lorca, Lagerkvist, Gide, Camus, Hesse) evolving toward a mythology of man. One course. *Salinger*

206. Autobiography. Origins and developments in the chief European literatures, including autobiographies of St. Augustine, Montaigne, Bunyan, Rousseau, Goethe, Carlyle, Nietzsche, Yeats, and Jung. One course. *Clubbe*

213, 214. The Slavs: Literature and Culture. (Also listed as Slavic Languages and Literatures 213, 214.) Two courses. *Krynski*

223. Structuralism and the New Criticism. (Also listed as French 223.) One course. *Fowlie*

285. Literary Criticism. (Also listed as English 285.) One course. *Lievsay*

MAJOR IN COMPARATIVE LITERATURE

Prerequisite. A reading knowledge of at least one foreign language; English 55, 56 or the equivalent.

Major Requirements. (1) Reading knowledge of a second foreign lan-

guage; (2) three courses in a single foreign literature, to be read in the original (committee approval required); (3) Comparative Literature 100 and two other comparative literature courses, at least one of which must be a 200-level course.

The Committee on Comparative Literature will assist the major in creating a program having unity and direction and will also advise him of pertinent conference courses and seminars offered each year in the various literature departments. Inquiries may be directed to Professor Salinger, Chairman of the Committee on Comparative Literature, 106 Languages Building.

Computer Science

Professor Loveland, *Chairman;* Professor Gallie, *Director of Undergraduate Studies;* Professors Marinos, Naylor, Nolte, and Woodbury; Associate Professors Hammond, Patrick, and Starmer; Assistant Professors Biermann, Foster, Geller, Gerhart, and Ramm; Adjunct Associate Professor Williams

The Department of Computer Science provides courses on the concepts of computing and computers, their capabilities and uses. Most courses require the student to make extensive use of one or more of the available computers as a problem-solving instrument. Students who wish to take a single introductory course in computer science, as part of their general education, usually elect Computer Science 51.

42. Introduction to Digital Systems. (Also listed as Electrical Engineering 42.) One course. *Marinos*

51. Introduction to Digital Computation. Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming, and least-squares techniques. One course. *Gallie and Staff*

51P. Preceptorial. Elective preceptorial for students enrolled in Computer Science 51. *Staff*

51X. Introduction to Digital Computation. Same as Computer Science 51. (For students who have had previous programming experience.) One course. *Staff*

71. Discrete Systems Analysis. (Also listed as Biomedical Engineering 71.) One course. *Pilkington*

150. Computers and Programming. Computer structure, machine language, instruction execution, addressing techniques, and digital representation of data. Computer systems organization, logic design, micro-programming, and interpreters. Symbolic coding and assembly systems, macro definition and generation, and program segmentation and linkage. Prerequisite: Computer Science 51. One course. *Staff*

150P. Preceptorial. Elective preceptorial for students enrolled in Computer Science 150. *Staff*

152. List Processing and Data Structures. Linear lists such as stacks, queues, deques, circular lists, and doubly linked lists; trees; multilinked structures; dynamic storage allocation. Exercises may require use of an assembly language. Prerequisite: Computer Science 150. (Also listed as Mathematics 152.) One course. *Staff*

152P. Preceptorial. Elective preceptorial for students enrolled in Computer Science 152. *Staff*

157. Introduction to Switching Theory. (Also listed as Electrical Engineering 157.) One course. *Marinos*

161. Numerical Solution of Ordinary Differential Equations. (Also listed as Mathematics 161.) One course. *Murray*

163. Data Analysis. Elements of probability and statistics, acquisition of data, maintenance of data bases, computation and display of statistical summaries. Prerequisites: Computer Science 51 and Mathematics 31 or equivalent. One course. *Woodbury*

191, 192. Independent Study. Directed reading and research for qualified juniors. Prerequisite: permission of the instructor and Director of Undergraduate Studies. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for qualified seniors. Prerequisite: permission of the instructor and Director of Undergraduate Studies. Two courses. *Staff*

For Seniors and Graduates

200. Programming Methodology. Practical and theoretical topics including structured programming, specification and documentation of programs, debugging and testing strategies, choice and effective use of programming languages and systems, psychology of computer programming, proof of correctness of programs, analysis of algorithms, and properties of program schemata. Prerequisite: Computer Science 152. One course. *Gerhart*

201. Programming Languages. Information binding, data structures and storage, control structures, recursion, execution environments, input/output; syntax and semantics of languages; study of PL/I, Fortran, Algol, APL, LISP, SNOBOL, and SIMULA; exercises in programming. Prerequisite: Computer Science 152. One course. *Gerhart or Geller*

203. Random Signals and Noise. (Also listed as Electrical Engineering 203.) One course. *Kerr or Nolte*

205. Signal Detection and Extraction Theory. (Also listed as Electrical Engineering 205.) One course. *Nolte*

208. Digital Computer Design. (Also listed as Electrical Engineering 208.) One course. *Marinos or Owen*

210. Image Processing. Digital image transducers and processing algorithms; special purpose filters and tracking algorithms as applied to both binary and multi-gray level images; transducer hardware such as flying spot scanners and image dissectors. One course. *Starmer*

215. Artificial Intelligence. Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem-solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or permission of the instructor. One course. *Biermann*

221. Numerical Analysis I. Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of nonlinear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) One course. *Patrick or Gallie*

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) One course. *Patrick or Utku*

223. Numerical Analysis III. Rational approximation methods, spline approximations, optimization techniques, global methods for solving nonlinear algebraic equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 223.) One course. *Patrick or Gallie*

225. Mathematical Foundations of Computer Science. Introduction to basic concepts and techniques used in mathematical models of computation. Elements of the predicate calculus; applications to automatic theorem proving and verification of programs. Notions of computable sets, functions, algorithmically unsolvable problems. Regular and context-free formal languages and the machines that define them. Prerequisite: four semesters of college mathematics. One course. *Loveland*

226. Mathematical Foundations of Computer Science II. Basic concepts and techniques used in the modeling of systems. Elements of probability, statistics, queuing theory, linear programming, linear systems, and error analysis. Prerequisites: four semesters of college mathematics. One course. *Foster*

231. Introduction to Operating Systems. Characteristics and components of operating systems and methods for their implementation. Program linkage and relocation, job scheduling, resource allocation and interrupt handling, input/output control systems, on-line file structures, communication, time sharing and real time systems. Case studies of existing systems. Prerequisite: Computer Science 152. One course. *Ramm*

232. Metaprograms. Programs which process programs: compilers, interpreters, and assemblers. Syntax and semantics of programming languages. One course. *Geller*

241, 242. Information Organization and Retrieval. Structure, analysis, organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching procedures, indexing, file maintenance and methods for user interaction with the automated system. Programming experience included. Prerequisite: Computer Science 152. Two courses. *Hammond*

244. Econometrics II. (Also listed as Economics 244.) One course. *Naylor*

250. Clustering and Classification. Algorithms and operating characteristics of clustering and classification methods. Data models for sequential data acquisition, clustering in terms of nearest neighbor and/or mixtures of distribution. Bayes' procedures for classification into clusters and superclusters. Prerequisite: permission of the instructor. One course. *Woodbury*

265. Advanced Topics in Computer Science. One course. *Staff*

270. Computer Communication Systems. Elements such as terminals, processors, lines, network structures, control techniques, and softwear; design tradeoffs; performance prediction with emphasis on simple approximate analytic techniques. Prerequisites: familiarity with computer structures and operating systems and calculus; probability or statistics is desirable. One course. *Spragins*

DEPARTMENTAL MAJOR

The B.S. Degree

Prerequisites. Computer Science 51; Mathematics 31, 32, 103, 104.

Major Requirements. Computer Science 150, 152, three of the following: 157, 163, 200, 215, 221, 225, 231, 232, 241; and one more course in Mathematics at the 100-level or above. The student must take enough additional courses so that he has completed at least 5 courses (excluding Mathematics 103, 104) at the 100-level or above in one department other than computer science. All students of computer science are urged to acquire at least a rudimentary knowledge of statistics.

Students planning to do graduate work will probably find a reading knowledge of at least one foreign language useful. Students who expect to do their graduate work in computer science should try to include Computer Science 221 and modern algebra in their course of study.

Drama

Assistant Professor Clum (English), *Chairman of the Interdisciplinary Committee on Drama;* Professors Cordle (French), Fowlie (French), Truesdale (Classical Studies), and Wardropper (Spanish); Associate Professors Jezierski (Slavic Languages), Michalak (English), Reardon (English), and Stewart (Romance Languages); Assistant Professor Alt (German); Instructors Altman and Parker

No major is offered in drama, but a course program including the basic courses in practical theater listed below should prepare one for further study on the graduate level. These courses should also serve to develop the skills of the interested amateur.

Note that Drama 101, 102, 103, and 105 and English 120 and 130 are skill courses and, as such, do not satisfy distributional requirements.

PRACTICAL THEATER

101. Acting. Basic acting skills; diction, movement, improvisation, interpretation. One course. *Staff*

102. Advanced Acting. Advanced work in interpretation and scene study. Prerequisite: Drama 101. *Staff*

103. Directing. Basic training in casting, blocking, and interpretation. One course. *Staff*

105. Educational Theater. Training in producing and directing junior high and high school productions: play selection, casting, publicity, ticket sales, basic directing. One course. *Clum*

191-194. Independent Study. Intensive study or special projects in theater history or practical theater approved by the Interdisciplinary Committee on Drama. One course. *Staff*

See also the following courses in English: 120, Stagecraft (Michalak); 130, Play Production (Michalak).

THEATER HISTORY

English

119. History of the Theater. *Michalak*

DRAMATIC LITERATURE

Classical Studies

114. Greek Drama. *Burian and Rigsby*

English

22S. Studies in Drama. *Staff*

129. English Drama from the Middle Ages through the Eighteenth Century. *Clum or Reardon*

159. English and Irish Drama of the Nineteenth and Twentieth Centuries. *Clum or Reardon*

169. Modern European Drama. *Clum or Reardon*

179. American Drama. *Clum or Reardon*

181S. Conference on Drama. *Staff*

French

110. French Comedy in the Seventeenth and Eighteenth Centuries. *Stewart*

111. French Drama of the Nineteenth Century. *Staff*

112. French Drama of the Twentieth Century. *Cordle or Staff*

151. Theory and Form of Tragedy. *Fowlie*

233. Contemporary French Theater. *Fowlie*

German

115S. Drama (1770-1890). *Alt*

Romance Languages

160. An Approach to Comedy. *Wardropper*

Slavic Languages

105. The Russian Theater and Drama. *Jezierski*

Economics

Professor Kelley, *Chairman*; Assistant Professor Black, *Director of Undergraduate Studies*; Professors Blackburn, Bronfenbrenner, Davies, Goodwin, Kreps, Naylor, Saville, Treml, Vernon, Wallace, and Yohe; Associate Professors Grabowski, Graham, Havrilesky, Tower, and Weintraub; Assistant Professors Bolnick, Cook, de Marchi, Lipscombe, McElroy, and Wyse

Economics courses aim to develop in the student the critical and analytical skills essential for understanding economic problems and institutions, in both their contemporary and in their historical setting. Although no particular vocational or professional goal is emphasized, these courses provide the academic background necessary for positions in industry, for work in many branches of government service, for law school, and for graduate study in business administration, economics, and the social sciences.

Students planning to do graduate work in economics are advised to take as many of the following courses in mathematics (listed in preferential order) as their schedules permit: Mathematics 31, 32, 103, 104, 131, and 135-136.

1. National Income and Public Policy. Basic economic analysis emphasizing current public policy issues. How the level and rate of growth of aggregate national income and output are determined. What causes unemployment, inflation, and international payments problems. How monetary policy (money supply and interest rates) and fiscal policy (government expenditures and taxes) affect these problems. (Open only to freshmen.) One course. *Staff*

2. Competition, Monopoly, and Welfare. A continuation of Economics 1. How the composition of the economy's output and the distribution of its income (who is rich and who is poor) are determined in a market economy by supply and demand. How and why markets work or fail to work and the implications of social policies. Role of government in a market economy: contemporary problems of the environment, topics such as environmental economics, monopoly, unionism, international trade. Comparison of a market economy with other systems of economic organization. Economic problems of developing countries. (Open only to freshmen.) One course. *Staff*

51. National Income and Public Policy. See Economics 1. (Open to all students.) One course. *Staff*

52. Competition, Monopoly, and Welfare. See Economics 2. (Open to all students, except those who have had Management Sciences 50.) One course. *Staff*

51D, 52D. The same courses as Economics 51, 52 except taught as lectures with discussion sections. Two courses. *Staff*

53. Economics of Contemporary Issues. Modern economic problems, such as environmental deterioration and urban decay. The market, as one of the interrelated subsystems of the social system, from institutionalist, Marxist, and other perspectives in the social sciences. One course. *Havrilesky*

106. The Economics of Poverty. Poverty in the United States: its definition, measurement, history, racial dimensions, and present and proposed policies for its amelioration. Prerequisite: Economics 52. One course. *Kreps*

107. Economics of the Environment. Theory and practical analysis of the interdependence between environmental quality and consumption, production, public policy, and economic growth. One course. *Staff*

108. Economics of War. Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex, disarmament and the economy. Prerequisite: Economics 52. One course. *Weintraub*

114. Economic Geography of Africa. A continental study of the natural environmental factors of Africa and the basic economic patterns of adjustments and adaptations on regional or national bases. One course. *Tuthill*

115. Fundamentals of Geography. A functional social studies approach to geographic factors and their interrelationships. One course. *Tuthill*

116S. Economic Geography of Anglo-America. Geographic and economic regions of the United States and Canada; their resource base and the major economic activities, their spatial distribution and relative significance. One course. *Tuthill*

120. Economic Geography of Asia. Concepts of agricultural, manufacturing, and distributive location theory, resource evaluation, and regional planning in Asia. One course. *Tuthill*

132. Development of the American Economy. From first settlement to present: quantity of goods and quality of life; employment and leisure; domestic and foreign commerce; poverty and affluence; money and prices; slavery, agriculture, and ghettos; business and labor; and roles and policies of governments. One course. *Saville*

134. Quantitative Analysis in Economics. Partial derivatives. Lagrange

multiplier methods, matrix theory, and difference and differential equations. Prerequisite: Mathematics 31. One course. *Staff*

138. Economic Statistics. Survey of principal concepts and methods of application to economics. (Not open to students who have had Mathematics 53 or 183, Management Sciences 110, Psychology 117.) One course. *McElroy, Vernon, Wallace, or Wyse*

139. Introduction to Econometrics. Data collection, estimation, and hypothesis testing. Use of econometric models for analysis and policy. Prerequisites: Mathematics 31 and 32, or equivalent, and Economics 138 or Management Sciences 110 or equivalent. One course. *McElroy, Vernon, Wallace, or Wyse*

149. Microeconomic Theory. Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. (Not open to students who have had either Economics 161 or Public Policy Studies 110.) *Black, Graham, McElroy, Treml, or Vernon*

150. History of Economic Thought. Includes approaches to economic problems from Aristotle to Samuelson, emphasizing certain models and doctrines—their origins, relevancy, and evolution. Readings from Mun, Quesnay, Adam Smith, Malthus, Ricardo, Marx, Pareto, and Keynes. One course. *de Marchi or Goodwin*

153. Monetary Economics. The evolution and operations of commercial and central banking and nonbanking financial institutions in the United States, the determination of monetary aggregates and interest rates, the financial impacts of Treasury operations, and the linkages from Federal Reserve actions to price level, employment, economic growth, and balance of payments objectives. One course. *Yohe, Havrilesky, or Bolnick*

154. Aggregative Economics. Concepts and measurement of national income and expenditures, employment, interest rates, and price levels; the theoretical determination of these aggregates; applications of macroeconomic theory to business cycles and economic growth. One course. *Black, Bronfenbrenner, Havrilesky, Yohe, or Tower*

155. Labor Problems. Analysis of labor force participation, internal and dual labor markets, wage-price relationships, income maintenance experiments, investments in human capital, current manpower policies and programs. One course. *Kreps or Wyse*

184. Canada: Problems and Issues of an Advanced Industrial Society.* (Also listed as Interdisciplinary Course 184.) *Preston and Visiting Lecturers*

189. Business and Government. Public policies which most directly affect the operation of competition in the business world. The economic basis for an evaluation of antitrust policy, public utility regulation, and public enterprise. Prerequisite: Economics 149 or consent of instructor. One course. *Grabowski or Vernon*

191, 192. Independent Study. Directed reading and research. Admission will be subject to approval of the individual instructor and the department. Two courses. *Staff*

193, 194. Independent Study. Same as Economics 191, 192 but for seniors. Two courses. *Staff*

*This course does not count toward the 7 courses required for an economics major.

198S. Topics in Market Organization. Market structures, related economic and legal issues, and attempted policy solutions in the United States. Prerequisite: Economics 149. One course. *Grabowski or Vernon*

199. The Changing South. (Also listed as Interdisciplinary Course 199.) One course. *Staff*

Junior-Senior Seminars in Economics

The seminars are open to all majors in economics, with the permission of the department.

201S.1. Current Issues in Economics. Economic analysis of various public issues and policies. Readings, reports, and discussion on the health care system, crime and punishment, pollution and the environment, the performing arts, welfare, the energy crisis, and other topics. One course. *Davies*

201S.2. Mathematical Economics. Selected mathematical tools from symbolic logic, naive set theory, linear algebra, calculus, analysis and elementary topology applied to the analysis of economic problems. Topics include consumer choice, production, general equilibrium, and growth. Prerequisites: two semesters of college calculus and Economics 149. One course. *Graham*

201S.3. Economics of Higher Education. An analysis of the demand for educated manpower, public and private costs and benefits, the role of private higher education, public policy in higher education, and other topics. One course. *Blackburn*

201S.4. Conflict and Cooperation in Economics. Elements of game theory. Both cooperative and non-cooperative games with particular reference to economic problems such as trading, general equilibrium theory, oligopoly, and monopoly. One course. *Weintraub*

201S.5. Impact Analysis of Government Policies. The impact of government policies on income and employment utilizing methodology of input-output analysis. Applied problems: impact on environment, conflicting national priorities, technological change, marketing projections, foreign trade, shifts in demand, disarmament. One course. *Treml*

201S.6. Current Problems in International Monetary Arrangements. The breakdown of the international monetary system. Effects of alternative retaliatory schemes. Effects on the international transmission of business conditions of flexible exchange rates. Optimum stocks of international monetary reserves. Prerequisite: Economics 149 or 265. One course. *Tower*

Other Courses for Upperclassmen

200. Capitalism and Socialism. Selected ideological classics of new and old right and left economics including both "counsels for perfection" (Utopias) and "precepts for action" in political economy. Prerequisite: Economics 149 or 154, or permission of instructor. One course. *Bronfenbrenner*

204S. Advanced Money and Banking. Monetary theory and its statistical and institutional implementation. Particular attention is given to the development of aggregative theories of prices, interest rates, and production; the functioning of monetary policy within various theoretical frameworks; and appraisal of the recent use and the limitations of Federal Reserve policy. One course. *Havrilesky or Yohe*

211. Introduction to Mathematical Economics. Applications of topics in

calculus, differential equations, and linear algebra to the theory of the firm, capital theory, macroeconomics, cycles, growth, and linear economic models. Prerequisites: Economics 149 and 154 and Math. 31 and 32, or equivalent. One course. *Graham*

212S. Economic Science and Economic Policy. An historical examination of the impact of economics on public policy; special attention to agriculture, labor relations, the Council of Economic Advisors, and the experience of other countries. One course. *Goodwin*

214. Geonomics: Geography and Contemporary Economics of Africa. Environmental factors in relationship to major economic activities, emphasizing the resource base, ecological adjustments, landscape morphology, and international interdependence. A series of national studies synthesized into a continental format. Prerequisite: permission of the instructor. One course. *Tuthill*

219. Economic Problems of Underdeveloped Areas. Consideration and analysis of the economic and related problems of underdeveloped countries. Some attention will be given to national and international programs designed to accelerate the solution of these problems. One course. *Kelley, Naylor, Saville or Bolnick*

231S. Economic Development of Europe. Sequence of local, national, and international economic structures under situations of changing trade, industry, agriculture, population, investment, war conditions, public ownership, cartels, colonialism, and prices. One course. *Saville*

232. Economic History of Japan. Japanese economic development, stressing the period since the end of isolation. Prerequisite: one semester of economic analysis or of Far Eastern history. (Also listed as History 260.) One course. *Bronfenbrenner*

233. State and Urban Finance.* Expenditures, taxation, and financial administration in state and local governments, with emphasis on current problems. Special attention will be given to research methods and materials, and to the financial relations between state and local governments. *Black or Davies*

234. Urban Economics. Economic factors which influence the internal development of metropolitan areas. Urban problems involving slums, ghettos, poverty, and transportation are analyzed from an economic point of view. Prerequisite: Economics 149 or consent of instructor. One course. *Black*

235. The Economics of Crime, Law Enforcement, and Justice. An analysis of the social costs of law enforcement and crime, a theoretical and empirical study of criminal deterrence, the measurement and production of law enforcement outputs, and an economic analysis of the courts and correctional system. Prerequisite: Economics 149 or equivalent. One course. *Cook*

237, 238. Statistical Methods. A study of statistical methods appropriate for dealing with problems in business and social science. In addition to developing more thoroughly the subject considered in Business Statistics, the following methods will be considered: simple, multiple, partial, and curvilinear correlation; curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of the instructor. Two courses. *Staff*

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*Offered on demand.

243. Econometrics I. Economic theory, mathematics, statistical inference, and electronic computers applied to analysis of economic phenomena. Objective is to give empirical content to economic theory. Matrix algebra used to develop topics in inference, linear regression, and systems of simultaneous equations. Use is made of the electronic computer. One course. *Naylor or Wallace*

244. Computer Simulation Models of Economic Systems. A course on the design of computer simulation experiments for economic systems. Topics include generation of stochastic variates, computer models of queuing and inventory systems, models of the firm and industry, models of the economy, simulation languages, and experimental design. (Also listed as Computer Science 244.) One course. *Naylor*

245. Econometrics II. Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making, simultaneous equation methods, and forecasting. Emphasis on current applied literature. A Track 1, third-level course (see section on Statistics). Prerequisite: Economics 243. One course. *McElroy or Wallace*

257. Manpower and Human Resources. Allocation of human resources; returns to investments in education and training; qualitative composition of the labor force. One course. *Kreps*

262. Trade Unionism and Collective Bargaining. An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. One course. *Staff*

265S. International Trade and Finance. A study of fundamental principles of international economic relations. Subjects covered include the economic basis for international specialization and trade, and the economic gains from trade, the balance of international payments, problems of international finance, investments, and monetary problems. Prerequisite: Economics 149. One course. *Bronfenbrenner or Tower*

287. Public Finance. Economic aspects of such problems as the growth of government, the proper role of the state, the centralization and decentralization of government, government bureaucracy, the impact of taxes and spending on the wealthy and the poor as well as other public policies and questions. One course. *Davies*

293. Soviet Economic History. Establishment of foundations of a socialist economy: collectivization, industrialization, and search for economic efficiency. One course. *Treml*

294S. Soviet Economic System. Economic planning and administration in the Soviet Union and other socialist countries. International comparisons. Theoretical and applied problems of resource allocation, economic development, and optimal microdecision-making in a nonmarket economy. One course. *Treml*

DEPARTMENTAL MAJOR

Prerequisites. Mathematics 31, Economics 1 or 51, Economics 2 or 52 (Management Sciences 50 will be accepted in lieu of Economics 2 or 52).

Major Requirements. Any 5 additional courses in the department. Substitution of courses in other departments for similar courses in the Eco-

nomics Department will not be permitted, with one exception—Mathematics 133 or Management Sciences 60, if taken prior to spring semester 1971-1972, may be substituted for Economics 138, thereby counting toward the 5-course requirement.

For graduation with distinction in economics, at least one junior-senior seminar course and a paper are required. Prerequisites for admission to a junior-senior seminar course are two of the following three courses: Economics 138, 149, 154. See section on Honors for other requirements.

Education

Professor Flowers, *Chairman;* Associate Professor Colver, *Director of Undergraduate Studies;* Professors Adams, Cartwright, Gehman, Githens, Hopkins, Petty, Shuman, and Weitz; Associate Professors Ballantyne, Carbone, Davis, Di Bona, Johnson, Katzenmeyer, Martin, and Pittillo; Part-time Instructor Swain

Students who expect to teach in the public schools should plan their courses in accordance with the general regulations set forth under Teaching. Students who intend to teach in elementary schools should consult with Professors Adams or Petty; those intending to teach in secondary schools should consult with Professors Cartwright, Githens, or Shuman. Students should confer with these advisers prior to registration each semester.

Students who do not expect to teach but desire an understanding of the school as part of a liberal education are advised to elect such courses as Education 100 and 113 for their introductory work in the department and then to elect further work in accordance with their special interests.

100. Social and Philosophical Foundations of Education. A study of the basic features, assumptions, viewpoints, and issues of education in contemporary America. This course or Education 113 is required of all who intend to practice teach and of all majors in education, and should be taken in the junior year. One course. *Carbone, Di Bona, Johnson,* or *Martin*

105. Elementary Education: Reading. Must be taken concurrently with Education 106. Half-course. *Adams*

106. Elementary Education: Language Arts. Must be taken concurrently with Education 105. Half-course. *Adams*

107. Elementary Education: Arithmetic. The processes, methods, and materials basic to the teaching of arithmetic in the elementary schools. Required in the elementary-education major. Half-course. *Petty*

108. Elementary Education: Science. The principles, methods, and materials basic to the teaching of the sciences in the elementary school. Required in the elementary-education major. Half-course. *Githens*

113. History of American Education. A study of American education from colonial times to the present. The development of schools, their organizations, administration, curriculum, and methods as seen in relation to the social forces that have produced our particular type of civilization. One course. *Johnson*

118. Educational Psychology. Psychology of learning, individual and social development, and psychology of adjustment as related to problems of instruction and the process of education. Prerequisite: Psychology 102, 103, 104, or 105. One course. *Davis*

151. Public School Music Education. Required in the elementary-education major. (See Music Education 151 for description.) Half-course.

152. Public School Music Literature. Required in the elementary-education major. (See Music Education 152 for description.) Half-course.

161. Integrated Art in the Public School. Work in the materials and methods in basic two-dimensional art media. Half-course. *Stars*

162. Plastic Art in the Public School. Work in basic three-dimensional art; emphasis on ceramics. Half-course. *Stars*

168. Secondary Education: Teaching Reading. Teaching reading in the content areas; determining students' reading levels; locating, evaluating, and selecting instructional materials. One course. *Adams*

173, 174. Tutorial Practicum in Reading. Assessment of reading abilities and disabilities; instruction of individuals and small groups of elementary and/or secondary students enrolled in the Duke Reading Center. Prerequisite: Education 105-106 or Education 236, and permission of the instructor. One course. *Adams*

191, 192. Independent Study. Directed reading and research for juniors. Prerequisite: approval of instructor and the Director of Undergraduate Studies. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for seniors. Prerequisite: approval of instructor and the Director of Undergraduate Studies. Two courses. *Staff*

195S. Elementary Education: Principles. The nature, subject matter, and organization of elementary education for instruction in the primary and intermediate grades. Must be accompanied by Education 196. Half-course. *Petty*

196. Elementary Education: Internship. Full-time observation and teaching for half a semester. Prerequisites: Education 195S, C average overall and in the elementary education major; preparation for teaching in the elementary school; or consent of the instructor. This course combined with Education 195S will fulfill the seminar and independent study requirement. One and one-half courses. *Petty*

201. Teaching and Supervision of Arithmetic. Special attention is given to the number system, the fundamental operations (with whole numbers, fractions, and decimals), percentage, and measurements. Considered also are the meaning theory, methods of teaching, problem-solving, evaluation, practice and drill, and selection and gradation of arithmetical contents. Designed for teachers and supervisors in elementary schools. One course. *Petty*

202. Comparative and International Education: Industrialized Nations. Structure and functioning of educational institutions in selected developed societies. Relevant social science theory and methods. One course. *Di Bona*

206. Studies in the History of Educational Philosophy. The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. One course. *Carbone*

207. Social History of Twentieth Century American Education. Twentieth century American education in context of social and intellectual history. One course. *Johnson*

209S. John Dewey. Dewey's major writings with emphasis on his philosophy of education. One course. *Carbone*

215S. Secondary Education: Principles. Principles, curriculum and meth-

ods in secondary education. Prerequisite: C average overall and in teaching field or fields. Must be accompanied by Education 216. Half-course. *Cartwright, Githens, Johnson, or Shuman*

216. Secondary Education: Internship. Supervised internship in junior or senior high school. Full-time observation and teaching for half a semester. Prerequisites: Education 215S, C average overall and in the major or teaching field; preparation for a teaching field; or the consent of the instructor. This course combined with Education 215S will fulfill the seminar and independent study requirement. One and one-half courses. *Cartwright, Githens, Hurlburt, Johnson, or Shuman*

217. The Psychological Principles of Education. An advanced study of teaching, learning, and the learner. Selected problems guiding the reading of students will be discussed in class. One course. *Davis, Gehman, or Weitz*

218. Comparative and International Education: Developing Societies. Structures and functioning of educational institutions and processes in developing nations. One course. *Di Bona*

219. Comparative and International Education: South Asia. Traditional and modern educational developments in India and Pakistan. One course. *Di Bona*

221. Programs in Early Childhood Education. Examination of the objectives and philosophy underlying programs in early childhood education, including an overview of existing practices, research findings, and experimental projects dealing with social, emotional, physical, and cognitive development. One course. *Flowers*

222. New Developments in Elementary School Curriculum. The open classroom, team teaching, non-graded programs, and individualized instruction. Assessment of recent emphasis on early childhood education and the middle school. One course. *Staff*

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course. *Cartwright*

226. Teaching Developmental and Remedial Reading in the Elementary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. One course. *Adams*

233. Improvement of Instruction in English. Recent developments and research techniques in the teaching of English with individual projects. Prerequisite: permission of the instructor. One course. *Shuman*

236. Teaching Developmental and Remedial Reading in the Secondary School. A study of the nature of the reading process and of principles, methods, and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. For secondary school teachers of all subjects who wish to improve the reading and study habits of their students. One course. *Adams*

237. The Teaching of Literature in Secondary Schools. Literature generally taught in secondary schools. Adult and transitional literature are considered. Methods of organizing the program and of teaching literature. One course. *Shuman*

239. The Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School. Recent developments in the teaching of grammar, composition, mechanics, and usage. Students will write and grade compositions. Term project. One course. *Shuman*

241. Foundations of Counseling and Personnel Services. Scope, principles, historical background, services, trends, and issues of counseling, and pupil personnel services. One course. *Ballantyne or Colver*

246. The Teaching of Mathematics. The course deals with such topics as aims, curriculum, course and lesson planning, and classroom procedure for teaching secondary school mathematics. One course. *Staff*

253. Introduction to Law and Education. Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. One course. *Martin*

254. Law and Higher Education. Concepts and procedures relating to higher education. Emphasis upon court decisions. Prerequisite: Education 253 or permission of the instructor. One course. *Flowers*

255. Assessment of Abilities. The selection, use, and interpretation of various instruments for predicting and evaluating the outcome of educational experiences including surveys of standardized tests of aptitude and achievement. One course. *Colver*

256. Classroom Assessment of Student Achievement. The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. One course. *Colver*

258. Assessment of Personality, Interests, and Attitudes. The rationale, construction, use, and interpretation of standardized instruments designed for the assessment of students' interests, attitudes, and personalities. Emphasis on counseling applications. Prerequisites: Education 243 and 255 or approval of the instructor. One course. *Colver or Weitz*

259. Problems in Law and Education. Concentration on current issues, research cases, constitutional decisions, and statutes. Prerequisite: Education 253 or permission of the instructor. One course. *Martin, Pittillo, or Flowers*

266. Basic Science for Teachers. Presentation of basic concepts in natural and physical science through selected readings, the use of simple experiments and demonstrations, construction and use of equipment, and field studies. One course. *Githens*

276. The Teaching of High School Science. Discussion, lectures, and collateral reading related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary-school science. One course. *Githens*

DEPARTMENTAL MAJOR

Majors in education are offered in elementary school education and science education. The Department offers work leading to graduation with distinction. See the section on Honors in this *Bulletin*.

Duke Univerity is accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers. The programs are also approved by the North Carolina Department of Public Education.

The program for students who intend to teach is designed to prepare for positions either in elementary or secondary schools. Prerequisites for all prospective teachers are Psychology 102, 103, 104, or 105, preferably during the sophomore year, and Education 100 or 113, preferably during the junior year. Only students with a C average overall and in the major or teaching fields will be admitted to student teaching. Special methods courses should be taken prior to undergraduate student teaching, which is part of a planned professional semester in the senior year.

Elementary Education. A major in this program is designed for those students who desire to meet the certification requirements for teaching in the elementary school.

Required General Education Courses

English	1 course or by examination
Foreign language	Second year (or equivalent) or 2 courses in fine or practical arts
Biological Science	2 courses
Mathematics	1 course
History 91-92	2 courses
Political Science 61	1 course
Economics 115 or 120	1 course
Literature	1 course
Psychology 102, 103, 104, or 105	1 course

Required Specialized Subject Matter Courses

Physical Education (for Early Childhood or Intermediate Grades)	½ course
Health Education 134	½ course
Music Education 151-152	1 course
Education 161-162	1 course
Education 105	½ course
Education 106	½ course
Education 107	½ course
Education 108	½ course

Required Professional Courses

Education 100 or 113	1 course
Education 118	1 course
Education 195S	½ course
Education 196	1½ courses

A major in elementary education must include the concentration of at least 6 courses in subjects commonly taught in elementary school, chosen from one of the divisions—humanities, natural science, or social science. The concentration may include courses from the general education requirement.

Secondary School Teaching. Whatever their majors, students preparing to teach must consult the appropriate professional adviser in the Department of Education prior to each registration period to assure that they will be eligible to enter the required student teaching program. Students preparing to teach in a secondary school meet certification requirements by qualifying in one teaching field. Prospective secondary-school teachers must major in a subject other than education. Qualifications for certification to teach a single science may be sought under either the A.B. or the B.S. degree. Students desiring to major in science education should read the description of that program given below.

Science Education. Students intending to teach sciences in secondary schools may major in science education. The program meets certification re-

quirements and provides a broad background in several sciences. Early consultation with advisers in the Department of Education and a selected department in science or mathematics is required. Five courses in education (100 or 113, 118, 215S, 216, 246 or 276) are required. The Science Education program provides the required 2 courses in mathematics and laboratory work in at least three sciences, with concentration in one of these. University curriculum requirements account for a maximum of 14 courses. The remaining 18 are selected to provide breadth in at least three sciences and must include a minimum of 4 advanced courses. The general and professional courses required for certification may be met in part both by the University curriculum distribution and within the 18 courses devoted to concentration.

A major in science education leads to an A.B. degree within the normal 32 course limit. Students wishing to have the B.S. degree may expect to take more than 32 courses. The normal number of courses may be reduced by advanced placement or proficiency tests in English and foreign language.

Materials and Methods Courses. Certain courses concerned with materials and methods in teaching various subjects in the public school curriculum are listed in the proper subject matter department. These courses are intended to give credit for teaching certificates and are recommended by the Department of Education for such credit.

STUDENT TEACHING

During the eight weeks of student teaching, students should plan to live in a community which is some distance from Durham. This will entail additional living expenses to be borne by the student teacher. Room rent refund is not made.

English

Professor Budd, *Chairman;* Associate Professor Butters, *Director of Undergraduate Studies;* Associate Professor Gerber, *Supervisor of Freshman Instruction;* Professors Anderson, Bevington, Cady, Duffey, Ferguson, Lievsay, Nygard, Price, Randall, Reiss, Ryals, Smith, Turner, and Williams; Associate Professors Clubbe, Harwell, Jackson, Jones, Mellown, Michalak, Monsman, Reardon, Strandberg, and Wetherby; Assistant Professors Adams, Applewhite, Clum, and DeNeef; Part-time Visiting Assistant Professor Armitage; Part-time Lecturers Sammons, Wildman, and Wittig

WRITING AND LANGUAGE

1. Freshman Composition. Weekly expository themes based on British and American prose fiction and non-fiction; one general lecture, one section meeting, and one individual conference each week. One section of this course is reserved for students interested in creative writing. One course. *Staff*

10. Introductory Composition and Literature. A skills course in composition and literature (contemporary essays and short stories), with frequent writing assignments: five meetings each week and regular individual conferences. (This course, offered in the Summer Transitional Program, does not satisfy the English composition proficiency requirement.) One course. *Staff*

65S, 66S. Imaginative Writing. Informal essay, short story, poetry, drama, and film. Prerequisite: permission of the instructor. Two courses. *Monsman*

101S. Advanced Expository Writing. Designed for students interested in

expository writing, this is a course in advanced composition. It includes also business letters and reports. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Harwell*

103S, 104S. Creative Writing. Class discussion of students' manuscripts and individual conferences with the instructor. Open to sophomores, juniors, and seniors. Students desiring admission to either course should present a piece of writing to the instructor as early as possible during the preceding semester. Two courses. *Applewhite, Bevington, Monsman, or Price*

105S. The Composition of Prose Narrative. The writing of a novel or novella or a group of short stories. Primarily for juniors and seniors; permission of instructor required early in the preceding semester. One course. *Price*

106S. The Writing of Poetry. A study of meter, image, tone, and dramatic organization in traditional and modern poems as a basis for original composition. Prerequisite: permission of the instructor. One course. *Applewhite*

107. Introduction to Linguistics. Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. Prerequisite: sophomore standing. (Also listed as Anthropology 107.) One course. *Staff*

108. Development of the English Language. An elementary historical study of the English language: patterns of change and growth, with some attention to methods of philological inquiry and the relations of philology to literary studies. One course. *Butters*

109. Modern English Grammar. A descriptive study of written and spoken American English of the present time, with attention to standards of usage and pronunciation and the relations of grammar to composition. One course. *Butters*

ENGLISH AND AMERICAN LITERATURE

Introduction to Literature. One course each; English 26 may be taken twice.

20. (This number represents 1 course credit for advanced placement.)

21S. Studies in the Novel.

22S. Studies in Drama.

23S. Studies in the Short Story.

24S. Studies in Poetry.

25S. Studies in Epic.

26. Studies in Special Topics. (Many of the sections of this course are taught as seminars; see the Schedule of Courses.)

55, 56. Representative British Writers. Usually these works are studied in the first semester: Chaucer's Prologue to *The Canterbury Tales* and at least two tales, Shakespeare's *Henry IV, Hamlet,* or *King Lear,* and one other play, John Donne's poetry (selections), Milton's *Paradise Lost* (selections) and some of the shorter poems; in the second semester: novels by Fielding *(Joseph Andrews)* and Dickens *(Great Expectations),* and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. Two courses. *Staff*

57, 58. Representative American Writers. Selections and complete works. The first semester includes Poe, Emerson or Thoreau, Hawthorne, Melville,

Whitman, Dickinson, and Twain; the second semester includes James, Frost or Robinson, Crane or Dreiser, O'Neill, Faulkner, Hemingway, and others. Prospective majors should take courses numbered 173 through 176 instead of this course. Two courses. *Staff*

112. English Literature of the Middle Ages. A study of the principal forms and examples of English prose, poetry, and drama of the Anglo-Saxon and Middle English periods (excluding Chaucer), read in translation. One course. *Reiss*

115. Chaucer. *The Canterbury Tales* and the minor poems, with attention to their literary and social background. One course. *Adams, DeNeef, Nygard, or Reiss*

121. English Literature of the Sixteenth Century. Emphasis in poetry on Wyatt, Sidney, Spenser, Raleigh, Shakespeare; in prose on Sidney and Florio's *Montaigne;* in drama on Marlowe. One course. *DeNeef*

123, 124. Shakespeare. In the first semester twelve plays before 1600; in the second semester about ten plays after 1600. Two courses. *DeNeef, Jones, Lievsay, or Williams*

125, 126. English Literature of the Seventeenth Century. First semester: emphasis in poetry on Jonson and the cavaliers, Donne and the metaphysicals; in drama on Jonson, Tourneur, Webster, Ford; in prose on character writers, Bacon, Burton, Donne, Browne. Second semester: emphasis in poetry on later metaphysicals, Cowley, Denham, Waller, Dryden; in prose on Taylor, Dryden, Hobbes, Locke; in drama on Dryden, Congreve, Etherege, Wycherly. Two courses. *DeNeef or Randall*

127. Milton. Milton's poetry and prose, their relation to the period and to other great works of literature. One course. *Lievsay or Price*

129. English Drama from the Middle Ages through the Eighteenth Century. Emphasis on Tudor and Stuart drama, exclusive of Shakespeare. One course. *Clum or Reardon*

131, 132. Eighteenth Century Literature. The writers emphasized in the first semester are Pope, Swift, Defoe, Addison, Steele, and Fielding; in the second semester, Johnson, Gray, Boswell, Goldsmith, Sheridan, Blake, and later novelists. Two courses. *Ferguson or Jackson*

138. The English Novel from the Beginnings to 1800. Some of the writers studied are Nashe, Deloney, Lyly, Sidney, Bunyan, Behn, Defoe, Richardson, Fielding, Smollett, and Sterne. One course. *Jackson or Randall*

141, 142. English Literature of the Early Nineteenth Century. The course begins with the forerunners of Romanticism. The chief emphasis in the first semester is on the work of the older Romantics: Wordsworth, Coleridge, Lamb, and Hazlitt. In the second semester the chief emphasis is on the work of the younger Romantics: Byron, Shelley, Keats, and DeQuincey. Two courses. *Applewhite or Clubbe*

145, 146. English Literature, 1832-1900. A study of the major writers of poetry and prose from Macaulay to Hardy. In the first semester, Macaulay, Tennyson, Carlyle, the Brownings, Newman, Mill, Clough, and FitzGerald; in the second semester, Arnold, the Rossettis, Ruskin, Patmore, Meredith, Huxley, Morris, Swinburne, Pater, and Hardy. Collateral reading from novels of the period. Two courses. *Harwell, Monsman, or Ryals*

148. The English Novel in the Nineteenth Century. Some of the writers studied are Scott, Austen, Dickens, Thackeray, Trollope, the Brontes, George Eliot, Meredith, Butler, and Hardy. One course. *Clubbe, Harwell, or Monsman*

151, 152. English Literature of the Twentieth Century. Emphasis on principal writers of fiction, drama, and poetry. First semester: usually Conrad, Shaw, Yeats, Wells, Synge, Forster, Woolf, and Joyce. Second semester: usually Lawrence, Cary, Huxley, Auden, Greene, Beckett, and Dylan Thomas. Two courses. *Bevington, Mellown, or Smith*

153, 154. Twentieth Century Poetry. A study of twentieth century poetry and criticism of poetry in England and America. Problems in critical analysis and interpretation. First semester: the emphasis is on sources in nineteenth century symbolism and on the poetry of Hopkins, Yeats, Eliot, Pound, and Stevens. Second semester: the emphasis is on the poets and the poetic theories of the last thirty years. Two courses. *Bevington, Mellown, or Smith*

158. The English Novel in the Twentieth Century. Some of the writers studied are Conrad, Lawrence, Forster, Joyce, Woolf, Huxley, Cary, Amis, and Golding. One course. *Mellown or Smith*

159. English and Irish Drama of the Nineteenth and Twentieth Centuries. Emphasis on the modern period. One course. *Clum or Reardon*

173. American Literature to 1800. Colonial authors, Bradford, Taylor, Cotton Mather, Edwards, Byrd, and Franklin, and authors of the early Republic such as Tyler, Freneau, and C. B. Brown. One course. *Staff*

174. American Literature from 1800 to 1860. Prose and poetry of American Romanticism: Emerson, Thoreau, Hawthorne, Poe, Melville, and Whitman. (Not open to students who have taken 57.) One course. *Staff*

175. American Literature from 1860 to 1915. Dickinson, Twain, James, the social and philosophical essayists, Crane, Dreiser, Robinson, and Frost. (Not open to students who have taken 58.) One course. *Staff*

176. American Literature, 1915-1960. Eliot, Fitzgerald, Hemingway, Faulkner, and their contemporaries. One course. *Staff*

177, 178. American Fiction. A survey of the novel and the short story. The first semester covers the nineteenth century from Washington Irving to Stephen Crane; the second semester covers the twentieth century through ten representative books. Two courses. *Anderson, Budd, or Clum*

179. American Drama. Representative plays from Colonial times to the present: a historical survey. One course. *Clum or Reardon*

Conference Courses. Seminars primarily for majors, with priority given to seniors. Emphasis on literary theory and critical writing, with intensive study of one or more authors. One course each; each course may be taken twice.

180S. Conference on Criticism.

181S. Conference on Drama.

182S. Conference on Poetry.

183S. Conference on Fiction.

184S. Conference on Prose Non-Fiction or a Special Topic.

186. Modern Critical Methods. Major schools of modern criticism: formalistic, moralistic, psychological, biographical, historical, textual, mythic, aes-

thetic. Emphasis on the theoretical and practical writings of representative critics. One course. *DeNeef*

188. Contemporary American Writers. Novelists and poets prominent in the recent past. One course. *Staff*

191, 192, 193, 194. Independent Study. Directed reading and research. Students should consult the Director of Undergraduate Studies as early as possible in the semester preceding enrollment. One course each. *Staff*

195T. Tutorial. Directed reading and research. Prerequisite: approval of Director of Undergraduate Studies in the preceding semester. One course. *Staff*

197T, 198T. Distinction in English. Tutorials in the reading and criticism of selected British and American writers. Three essays the first term; three essays or an extended paper the second term. Upon recommendation of the tutors and completion of other requirements, the student may graduate with distinction in English. Admission by invitation of the department; students expecting to graduate early may take these courses in reverse sequence, beginning in the spring term preceding their graduation. Two courses. *Jones*

FOREIGN LITERATURES (IN TRANSLATION)

161. The European Background of English Literature. Influence of ancient and medieval literature. One course. *Harwell*

163, 164. Readings in European Literature. European literature in translation related to similar works in English. The first semester includes works by Rabelais, Cervantes, Voltaire, Goethe, and others. The second semester includes works by Balzac, Dostoevsky, Ibsen, Kafka, Sartre, Camus, and others. Two courses. *Clubbe*

165. Readings in Scandinavian Literature. A study of selections in translation from Ibsen, Strindberg, Lagerkvist, and others; their place in the literary tradition of Scandinavia and their relationships with English and American literature. One course. *Anderson*

167. Canadian Literature in English. Survey of nineteenth century writers. Emphasis on twentieth century poets and novelists such as E. J. Pratt, F. R. Scott, A. J. M. Smith, Earle Birney, Sinclair Ross, Hugh MacLennan, Irving Layton, Leonard Cohen, and Margaret Atwood. One course. *Armitage*

169. Modern European Drama. Ibsen to the present; the free theater movement and the drama of ideas. One course. *Reardon*

SPEECH AND THEATER

50. Essentials of Public Speaking. A basic course in public speaking, designed to give the student the poise and confidence necessary to think and speak freely before an audience. Particular attention is paid to the gathering and organization of speech materials and to oral presentation. Not open ordinarily to juniors and seniors. One course. *Michalak*

100. English for Foreign Students. Designed to assist the student to whom English is a second language to perfect his speaking and understanding of the language. Drills in writing, speaking, listening, and the American idiom. Open to all students and their wives, and to any persons and spouses with an official connection with the University. Those who do not pay full-time student fees may register for a fee of $5. No credit. *Staff*

110. Essentials of Public Speaking. A basic course in public speaking for juniors and seniors dealing with the same matters as 50. (Not open for credit to students who have taken 50.) One course. *Michalak*

119. History of the Theater. The origin and development of drama, acting, and stagecraft from ancient Greece to the modern European and American theater. Production problems of representative plays of the various periods will be discussed. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Michalak*

120. Stagecraft. An introductory course on the technical aspects of play production: scenery, lighting, properties, make-up, and costuming. Laboratory work will be coordinated with the various productions of the Duke Players. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Michalak*

130. Play Production. An introduction to the methods of producing a play—theater organization, play selection, casting, and rehearsal. Lectures and laboratory. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Michalak*

139. The Speaking Voice. A study of the mechanisms of speech. Emphasis is placed on providing the skills necessary for the improvement of voice, pronunciation, and diction. Methods of correcting minor functional speech disorders will also be studied. One course. *Wetherby*

140S. Argumentation. The principles of argumentation and debating. The techniques of analysis, investigation, evidence, reasoning, brief making, and refutation. Participation in class discussions and debates. One course. *Wetherby*

150. Persuasive Speaking. The psychological and sociological techniques used in gaining acceptance of ideas through speech. Study is made of the factors influencing human behavior; audience analysis and motivation; choice, arrangement, and adaptation of material. Extensive practice in persuasive speaking. One course. *Wetherby*

160, 170. Broadcasting. A study of the background of radio and television broadcasting. The first semester covers the development of broadcasting as an industry and as a literary form. The second semester studies the legal and social aspects, and various program forms. Two courses. *Wetherby*

GRADUATE COURSES OPEN TO UNDERGRADUATES

207, 208. History of the English Language. First semester, Old English; second semester, 1100 to the present. Two courses. *Nygard or Reiss*

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course. *Butters, Nygard, or Reiss*

210. Old English Literary Tradition. Poetry: heroic traditional (aside from *Beowulf*), the elegiac tradition, and the Caedmonian and Cynewulfian schools. Prose: Alfred, AElfric, and Wulfstan. Prerequisite: English 207. One course. *Nygard or Reiss*

212. Middle English Literary Tradition. From 1100 to 1500 (excluding Chaucer); medieval genres; reading of selected texts. A reading knowledge of Old or Middle English is recommended. One course. *Nygard or Reiss*

215. Chaucer. *The Canterbury Tales.* One course. *Nygard or Reiss*

216. Chaucer. *Troilus and Criseyde* and the minor poems. One course. *Nygard or Reiss*

221. English Prose of the Sixteenth Century. Readings in the major forms and authors. One course. *Lievsay*

222. English Nondramatic Poetry of the Sixteenth Century. Extensive select readings from representative types and authors, excluding Spenser. One course. *DeNeef or Lievsay*

223. Spenser. The reading of his works. One course. *DeNeef or Lievsay*

224. Shakespeare. The plays. One course. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. First semester: Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. Second semester: Jonson, Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. Two courses. *Randall*

229, 230. English Literature in the Seventeenth Century. Major works in prose and poetry from 1600 to the death of Dryden. Two courses. *Jackson, Lievsay, Randall, or Williams*

232. Milton. Milton's poetry and prose, with emphasis on the major poems. One course. *Lievsay*

234. English Drama, 1642-1800. The heroic play and comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. One course. *Jackson*

235, 236. The Eighteenth Century. Swift, Pope, Defoe, Addison, Steele, and others are studied in the first semester; in the second, Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. Two courses. *Ferguson or Jackson*

241, 242. English Literature of the Early Nineteenth Century. The Romantic poets and prose writers: first semester, 1790-1810, with emphasis on Wordsworth and Coleridge; second semester, 1810-1830, with emphasis on Byron, Shelley, and Keats. Two courses. *Clubbe*

245, 246. English Literature of the Later Nineteenth Century. The first semester is devoted chiefly to Carlyle, Dickens, Thackeray, Tennyson, and Browning; the second semester to Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. Two courses. *Clubbe, Monsman, or Ryals*

251, 252. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. The first semester will include Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence; the second semester, Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. Two courses. *Mellown or Smith*

263, 264. American Literature, 1800-1865. The writers emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. Two courses. *Anderson, Budd, Jones, and Turner*

267, 268. American Literature, 1865-1915. Selected works of representative authors. First semester: Whitman, Mark Twain, James, Howells,

Dickinson, and the Local Colorists. Second semester: Crane, Norris, Dreiser, Cather or Wharton, O'Neill, Robinson, and Frost. Two courses. *Budd or Cady*

270, 271. Southern Literature. Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Mark Twain, Ellen Glasgow, and Faulkner. Two courses. *Turner*

275, 276. American Literature Since 1915. First semester: selected fiction from Gertrude Stein to the present. Second semester: poetry from the Imagist movement to the present. Two courses. *Duffey or Strandberg*

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. One course. *Nygard*

285. Literary Criticism. Readings from the major critics, Plato to the eighteenth century with emphasis on formative ideas and historical continuity. One course. *Lievsay*

287. Recent Critical Thought. Questions of the nature and value of literature as reflected in recent criticism, theoretical and practical. One course. *Duffey*

289. Literary Biography. Selected works from Plutarch to Strachey with discussion of the historical development of biography, the various methods used and the various theories held about it. One course.

DEPARTMENTAL MAJOR

Basic Requirement. English 55-56.

Major Requirements. Seven courses at the 100 level or above: one course in a major author; three courses in period surveys, one in each division—(*a*) British Literature, before 1800, (*b*) British Literature after 1800, (*c*) American Literature; and three additional courses.

In choosing these three additional courses, the student should carefully consider with his adviser the opportunities available in the departmental offerings for concentration in English or American literature; in poetry, fiction, or dramatic literature; in historical periods; in critical theory, linguistics, or creative writing, or in speech and theater.

The English Department recommends that its majors complete at least two years of college-level study, or the equivalent, of a foreign language. Those majors contemplating graduate work in English should note than many M.A. programs require examination in one foreign language and that Ph.D. programs commonly require examination in two.

The department offers work leading to graduation with distinction. For further information consult the Director of Undergraduate Studies and the section on Honors in this *Bulletin*.

Forestry and Environmental Studies

Undergraduate students who are preparing for professional careers in forest resource sciences or administration should enroll in the Undergraduate Forestry Program, as described in the section on professional combination courses. The courses listed below are open to all undergraduate students in arts and sciences who have adequate preparation. Permission of the instructor is required.

FORESTRY

152. Conserving Natural Resources. Fundamentals of natural resource development, use, management, and protection based on principles of the natural and social sciences. One course. *Staff*

203. General Meteorology. Prerequisites: introductory courses in calculus and physics. One course. *Vukovich*

204. Microclimatology. Prerequisites: introductory courses in calculus and physics. One course. *Knoerr*

205. Tree Growth and Development. Prerequisites: introductory courses in botany and chemistry. One course. *Barnes*

206. Anatomy of Woody Plants. Prerequisite: Forestry 241 or plant anatomy. (Also listed as Botany 206.) One course. *Philpott*

215. Air Pollution Meteorology. Prerequisite: Foresty 203 or equivalent. (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from North Carolina State University). One course. *Staff*

222. Biology of Forest Insects and Diseases. Prerequisites: introductory courses in biology and physiology. One course. *Anderson and Stambaugh*

233. General Entomology. Prerequisite: Forestry 222 or equivalent. One course. *Anderson*

241. Dendrology (Taxonomy of Forest Trees). Prerequisite: introductory course in botany. One course. *White*

250. Biometry. Prerequisite: introductory courses in calculus. One course. *Yandle*

269. Resource Economics and Policy. Prerequisite: introductory course in economics. One course. *Convery*

ENVIRONMENTAL STUDIES

243. Natural Resource Ecology. Prerequisite: introductory course in botany. One course. *Wuenscher*

273. Economics and Environment Quality. Prerequisite: introductory course in economics. One course. *Convery*

Course descriptions and further information are given in the *Bulletin of the School of Forestry and Environmental Studies.*

French

For courses offered in French, see *Romance Languages.*

Genetics—The University Program

Professor Gross, *Director* (Biochemistry); Professors Amos (Microbiology and Immunology), Gillham (Zoology), and Guild (Biochemistry); Associate Professors Antonovics (Botany), Boynton (Botany), Counce (Anatomy), Kelley (Medicine and Biochemistry), C. Ward (Zoology), and Webster (Biochemistry); Assistant Professors Hall (Biochemistry), Harriman (Biochemistry), Kredich (Medicine and Biochemistry), and F. Ward (Microbiology and Immunology).

For a description of the following courses consult the listings under the specified departments.

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Students interested in preparation for advanced work in genetics or wishing to take an interdisciplinary major in this area should consult Dr. Ward (032 Biological Sciences Building). Information concerning interdisciplinary programs involving biology should be discussed with the appropriate directors of undergraduate studies.

117. Heredity and Society. (Listed as Zoology 117.) One course. *Ward*

180. Principles of Genetics. (Listed as Botany 180, Botany 280, Zoology 180, and Zoology 280.) One course. *Antonovics, Boynton, and Gillham*

186. Evolutionary Mechanisms. (Listed as Botany 186, Botany 286, Zoology 186, and Zoology 286.) One course. *Antonovics and H. Wilbur (Zoology)*

204. Introductory Genetics. (Listed as Biochemistry 204.) Half-course. *Gross and Staff*

216. Molecular Genetics. (Listed as Biochemistry 216.) One course. *Guild and Staff*

280. Principles of Genetics. (Listed as Botany 280 and Zoology 280.) One course. *Antonovics, Boynton, and Gillham*

282. Experimental Genetics. (Listed as Biochemistry 282.) Half-course. *Hall, Harriman, and Staff*

284. Current Topics in Genetic Mechanisms. (Listed as Biochemistry 284.) Half-course. *Hall and Staff*

285. Population Genetics. (Listed as Botany 285.) One course. *Antonovics*

286. Evolutionary Mechanisms. (Listed as Botany 186, Botany 286, Zoology 186, and Zoology 286.) One course. *Antonovics and H. Wilbur (Zoology)*

287S. Quantitative Genetics. (Listed as Botany 287.) One course. *Antonovics*

288. The Cell in Development and Heredity. (Listed as Zoology 288.) Half-course. *Counce*

Independent Study and *Special Problems* are offered in the Department of Botany under 191, 192, 193, 194, 225, and 226, and in the Department of Zoology under numbers 191 and 192. A student should obtain the permission of both the instructor with whom he wishes to work and the appropriate director of undergraduate studies before registering for these courses.

Geography

For courses offered in Geography, see *Economics*.

Geology

Professor Heron, *Chairman;* Associate Professor Furbish, *Director of Undergraduate Studies;* Professor Pilkey; Associate Professors Perkins and Lynts

1. Geological Environments and Man. Physical and chemical environ-

ments acting on the earth with special emphasis on their interaction with man. Three lectures and proficiency sessions to be arranged by students. One course. *Heron, Perkins, and Pilkey*

1P. Preceptorial. Field trips. Four hours once a month on Saturday. Elective for students enrolled in Geology 1. *Staff*

2. History of the Earth. Including the physical development and the geological evolution of life. Three one-hour lectures and one two-hour laboratory. Prerequisite: Geology 1 or consent of instructor. One course. *Lynts*

2P. Preceptorial. A weekend field trip to the classic Paleozoic section in the Appalachians of Virginia and West Virginia, and a one day field trip through the Deep River Triassic Basin. Elective for students enrolled in Geology 2. *Lynts*

3. Environmental Geology. Earth processes and materials, as related to man. Lectures, field trip, and eight hours of mini-lab. Not open to those who have completed Geology 1. One course. *Heron*

53. Introductory Oceanography. Basic principles of physical, chemical, biological, and geological oceanography. Prerequisite: one course in a laboratory science. (Also listed as Botany 53.) One course. *Pilkey and Searles*

54. Environmental Oceanography. The interaction of man and the marine environment. Lecture and field trips. Given biennially. One course. *Pilkey*

101. Crystallographic Mineralogy. Definition of the crystalline state, lattice and group concepts, indices, crystal systems, classification, and crystal morphology. Lectures and laboratory. One course. *Furbish*

102. Fundamentals of Mineralogy. Crystal chemistry, crystal physics, mineral identification, and genesis. Lectures or recitations, laboratory, and field trips. Prerequisites: Chemistry 12 (may be taken concurrently) and Geology 101. One course. *Furbish*

106. Igneous and Metamorphic Rocks. Silicate mineralogy, theory of origin and classification of igneous and metamorphic rocks and rock identification. Lectures and laboratory. Prerequisite: Geology 102. One course. *Furbish*

108. Sedimentary Rocks. Authigenic and detrital minerals, theory of origin and classification of sedimentary rocks and rock identification. Lecture, laboratory, and field trips. Prerequisite: Geology 1. One course. *Heron*

164. Introduction to Geologic Field Methods. Principles and techniques used in geologic mapping and field studies including applicable methods of surveying and the use of aerial photographs. Lectures, laboratory, and field trips. Prerequisites: Geology 1 and 2. One course. *Furbish*

169. The Marine Environment. For description see Marine Sciences.

171. Marine Sciences Seminar. For description see Marine Sciences.

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors and seniors by permission of the Director of Undergraduate Studies. Two courses. *Staff*

195. Problems in Earth Science. Open to qualified non-major juniors and seniors upon approval of the department. One course. *Staff*

For Advanced Undergraduates and Graduates

205. Geological Oceanography. The study of the broad geologic aspects

of the ocean basins, including origin, bottom physiology, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. Not open to students who have completed Geology 206. (Given at Beaufort.) One and one-half courses. *Pilkey*

206S. Principles of Geological Oceanography. A survey of geological aspects of the oceans including sediment types, processes of sedimentation, geologic structures of the ocean basins, and bottom physiography. Prerequisite: Geology 108 or consent of instructor. One course. *Pilkey*

208. Shallow-Marine Geology. Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marine environment. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. *Perkins*

211S. Stratigraphic Principles and Application. Prerequisite: Geology 108. One course. *Perkins*

212. Facies Analysis. Sedimentological models for the environmental interpretation of sedimentary sequences. Prerequisite: Geology 211. One course. *Perkins*

213. Sedimentology. Parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. *Pilkey*

214S. Sediments in Thin Section. Study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Prerequisite: Geology 213 or consent of instructor. One course. *Perkins*

222. Sedimentary Minerals. Structure and geologic occurrences of selective detrital and authigenic minerals including the clay minerals. Theory and use of X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. Prerequisite: Geology 102 or consent of instructor. One course. *Heron*

229. Economic Geology. Principles and processes involved when elements are concentrated to economic proportions in magmatic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisites: Geology 102. Given on demand. One course. *Furbish*

230. Principles of Structural Geology. Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. One course. *Staff*

233. Geochemistry. Application of the principles of chemistry to the solution of problems in geology. Prerequisites: Geology 102 and Chemistry 12. One course. *Staff*

241-242. Invertebrate Paleontology. Biologic and stratigraphic relationships of fossil invertebrates, with special emphasis on evolutionary trends of invertebrates as interpreted from fossil evidence. Lectures and laboratory. Prerequisites: Geology 1, 2, or consent of instructor. Given biennially. Two courses. *Lynts*

243, 244. Micropaleontology. Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution, and stratigraphic distribution. Lectures and laboratory. Prerequisites: Geology 241-242, or consent of instructor. Given biennially. Two courses. *Lynts*

247. Paleoecology. Application of ecologic and geologic principles to the reconstruction of the interrelationship between organisms and their environment in geologic time. Prerequisites: Geology 213, 242, or consent of instructor. Given biennially. One course. *Lynts*

DEPARTMENTAL MAJOR

The A.B. Degree

Prerequisites. Geology 1 and 2, Chemistry 11 and 12, and Mathematics 31 and 32.

Major Requirements. A minimum of 8 geology courses above the introductory levels, including 101, 102, 106, 108, 164, 211, and 230.

The B.S. Degree

The Department of Geology offers two programs:

1. *Geology*

Prerequisites. Geology 1 and 2, Chemistry 11 and 12, Mathematics 31, 32, and Computer Science 51.

Major Requirements. A minimum of 10 courses above introductory level including 101, 102, 106, 103, 211, 230, plus a field course normally taken during the summer of the junior year.

2. *Geology: Preparatory to Advanced Studies in Oceanography*

Prerequisites. Geology 1, 2 and 53 (or 206), Chemistry 11 and 12, Physics 51 and 52, Biology 11 and 12 or Biology 14, calculus and 3 courses of science electives.

Major Requirements. A minimum of 7 geology courses above the introductory levels, including 101, 102, 106, 108, 164, 211S, and 230.

Germanic Languages and Literature

Associate Professor Borchardt, *Acting Chairman;* Associate Professor Novak, *Director of Undergraduate Studies;* Assistant Professor Bessent, *Supervisor of Freshman Instruction;* Professors Phelps and Salinger; Assistant Professors Alt and Stern; Lecturer Blumstein; Instructors Dishman, Greenberg, and Von Ramm

1-2. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Two courses. *Bessent and Staff*

63. Intermediate German. Prerequisite: German 1-2 or equivalent. One course. *Staff*

German 63 is usually followed by 101, 117 or 182.

101. Introduction to German Literature. Readings from representative German authors. One course. *Staff*

103S, 104S. Seminars in German Literature in English Translation. Topics to be specified each semester. Two courses. *Staff*

105. Composition. Syntax with practice in the elements of German expository style, restricted to majors. One course. *Staff*

109S. Nineteenth Century Prose Fiction. Emphasis on shorter forms: Novelle, fairytale, legend. One course. *Alt or Borchardt*

115S. Drama (1770-1890). History of German drama and stagecraft from *Sturm und Drang* to the *Freie Bühne.* One course. *Alt*

117, 118. German Conversation and Composition. Primarily conversation with practice in writing. For German majors and other students by consent of instructor. Two courses. *Bessent*

119S. German Literature to the Goethezeit. Survey of German literature and its cultural backgrounds from the beginning through the Enlightenment. One course. *Alt or Novak*

125, 126. The Moderns. Problems and authors from Nietzsche and naturalism through expressionism to the present. Two courses. *Alt or Novak*

130. German Life and Thought. German cultural and intellectual history. Reading and discussion in English. One course. *Borchardt*

131. Goethezeit. Goethe and his contemporaries: representative texts and the philosophical background. One course. *Novak*

132. The Romantics. Major writers of the Romantic movement (1796-1830) considered in their national and international context. One course. *Salinger*

133S. The Lyric. Development of German lyric poetry from Goethe to Rilke. One course. *Alt or Salinger*

171. German Literature before 1900 in English Translation. One course. *Borchardt*

172. Modern German Literature in English Translation. Representative works by such writers as Mann, Kafka, Hesse, Brecht, Böll, and Grass. One course. *Borchardt or Salinger*

181, 182. German. An intensive introduction to the language open only to students who have achieved proficiency in another language. Two courses. *Novak*

191, 192. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by permission of the department. Two courses. *Alt, Borchardt, Novak, Phelps, Salinger, or Stern*

193, 194. Independent Study. Directed reading and research. Open only to qualified students in the senior year, by permission of the department. Two courses. *Alt, Borchardt, Novak, Phelps, Salinger, or Stern*

201S, 202S. Goethe. A study of his life and works, in the light of his lasting significance to Germany and world literature. First semester: lyrics, prose, fiction, and selected dramas; second semester: *Faust I & II.* Two courses. *Phelps*

203S, 204S. Eighteenth Century. Eighteenth century German literature in its relation to European intellectual currents of that time. Two courses. *Phelps*

205, 206. Middle High German. The language and literature of Germany's first classical period. Two courses. *Stern*

207S, 208S. German Romanticism. The principal writers of the period from 1800 to 1850. Two courses. *Staff*

209S, 210S. Kleist, Grillparzer, and Hebbel. The development of the drama in Germany and Austria between Schiller and Naturalism. Two courses. *Alt or Salinger*

211S, 212S. Nineteenth Century Literature. From the end of Romanticism through Realism. Two courses. *Alt*

213S. Heinrich Heine. A study of the poet and his impact on his age. One course. *Salinger*

214S. The Twentieth Century. Literature of the twentieth century presented through representative authors. One course.

215S. Seventeenth Century Literature. A study of the leading writers of the Baroque, viewed against the background of their time. One course. *Borchardt*

216. History of the German Language. The development of the phonology, morphology, and syntax of German from earliest beginnings to the present. One course. *Stern*

217S. Renaissance and Reformation Literature. The period from 1400 to about 1600. One course. *Borchardt*

218S. The Teaching of German. A survey of modern teaching techniques: problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. One course. *Phelps*

219. Applied Linguistics. Phonology, morphology, and syntax of German. Introduction to the systematic study of the vocabulary of modern German. Prerequisite: permission of the instructor. One course. *Stern*

232. Criticism. Critical concepts, craft of interpretation, and readings from the great critics. One course. *Alt or Borchardt*

DUTCH

181, 182. Dutch. Intensive introduction to the language of the Netherlands. Modern readings. Completion of second year college level (or equivalent) of another foreign language will normally be required. Two courses. *Stern*

191, 192. Independent Study. Directed reading and research for qualified juniors by permission of the department. Two courses. *Stern*

193, 194. Independent Study. Directed reading and research for qualified seniors by permission of the department. Two courses. *Stern*

YIDDISH

171. Yiddish Fiction in English Translation. Representative works of the classics (Mendele, Peretz, Sholem Aleikhem, Asch, Goldfaden) as well as of selected poets. One course. *Alt*

181, 182. Elementary Yiddish. A thorough study of elementary Yiddish grammar with reading, composition, and oral practice. No previous knowledge of German or Hebrew required. Two courses. *Alt*

DEPARTMENTAL MAJOR

Prerequisites. Elementary and Intermediate German.

Major Requirements. Conversation and Composition (German 117, 118, or equivalent), plus 6 advanced courses in the German Department, 3 of which must be on the 200-level. The following courses may not be used to fulfill major requirements: 103S, 104S, 171, 172, 181, 182.

Greek

For courses in Greek, see *Classical Studies*.

Health and Physical Education

PHYSICAL EDUCATION FOR MEN

Professor Friedrich, *Chairman of Health and Physical Education;* Associate Professor Skinner, *Director of Undergraduate Instruction;* Assistant Professor Corrie, *Director of Intramurals;* Assistant Professor Riebel, *Supervisor of Freshman Instruction;* Professors C. Falcone and Buehler; Associate Professors Cox and Persons; Assistant Professors Harvey and LeBar; Part-Time Instructors J. Falcone and Myers

Required Courses

Two semesters of physical education is required for graduation unless a student is excused for medical reasons. The requirement is met by the satisfactory completion of two semesters of physical education activity courses or by an alternate form of activity approved by the Men's Physical Education Department. This work will normally be completed in the freshman year.

All students are given a medical and physical examination before registration. Freshmen who have physical disabilities which prevent them from participating in regular classes should register for P.E. 11-12, Adapted Physical Education. Students who do not pass the basic swimming test are expected to register for P.E. 20, Beginning Swimming, during the spring semester of the freshman year.

Physical education courses and independent activities are graded on the pass/fail basis. These grades are not counted toward continuation, graduation, or honors; neither are physical education required courses counted among the 32 courses needed for graduation.

11-12. Adapted Physical Education. Instruction adapted to the needs and capacities of students who have physical disabilities which prevent them from participating in regular physical education classes. No course credit. *Staff*

20. Beginning Swimming. This requirement may be waived by passing a departmental swim test.

Freshman Activity Courses

The activity courses listed below are electives for the freshman year. No course credit.

15. Individual Development
21. Intermediate Swimming
25. Swimming and Life Saving
26. Advanced Swimming and Water Safety
30. Beginning Golf ($25 fee)
31. Advanced Golf ($25 fee)
32. Handball/Paddleball/Squash
33. Fencing/Archery
34. Track & Field
35. Soccer-Lacrosse
36. Basketball
37. Badminton/Archery
40. Beginning Tennis
41. Gymnastics
42. Combatives
43. Advanced Tennis

Elective Activity Courses for Men

The activity courses listed below may be taken as electives on a pass-fail basis provided the following requirements are met: (1) They must be different

or more advanced than courses the student has taken previously. (2) The student must enroll in two semesters of activity courses in order to receive a half-course credit. (3) The maximum amount of credit which a student may earn for elective physical activity courses is 1 full course. Prerequisites: two semesters of required physical education.

100-101—Adapted Physical Education
110-111—Individual Development
121—Intermediate Swimming
125—Swimming and Life Saving
126—Advanced Swimming and Water Safety
127—Scuba Diving
130—Golf ($25 fee)
132—Badminton/Paddleball/Squash
133—Fencing/Archery
137—Badminton/Archery
140—Tennis/Vollyball
141—Gymnastics
142—Combatives

Certain non-credit departmental sponsored activities may be scheduled during the year. Included in this group of activities are: sailing, bowling, skiing, judo, and an outward bound program. Options for various coeducational Physical Education classes are also available.

Elective Professional Courses

The courses listed below are arranged to meet the increasing demand for teachers who are qualified to coach and teach physical education as well as for those who may have leadership responsibilities in the area of recreation. These courses are open as electives for students in high school teaching programs and others for whom such courses may be appropriate. Teaching majors may elect semester-courses in this group. Two semester-courses may be elected from the courses listed under Special Methods in Physical Education; 3 from the courses listed under Theory and Practice in Physical Education; and 1 from Health Education. The courses must be selected with the prior approval of the director of undergraduate studies from the student's major department, in order to meet the needs of the individual.

Special Methods in Physical Education

163. Coaching Baseball and Track in Secondary Schools. Theory and practice. Open to juniors and seniors. One course. *Buehler and Butters*

164. Coaching Basketball and Football in Secondary Schools. Theory and practice. Open to juniors and seniors. One course. *Falcone and Foster*

Theory and Practice in Physical Education

170. History and Principles of Physical Education and Sports. The objectives and scientific principles upon which physical education is based. The history of physical education is studied in order to show the changes in objectives, principles, and methods and as an aid in the interpretation of trends. One course. *Friedrich*

171. Recreational Administration and Leadership. Theories and philosophies of play and recreation with emphasis on leadership and application to community organizations, school, and family situations. One course. *Friedrich*

172. The Administration of Physical Education and Athletics in Secondary Schools. A case study of appraisal of athletic, health, and physical education problems experienced in the organization and administration of athlet-

ics, health, and physical education. Open to juniors and seniors. One course. *Friedrich*

173. Protective Practices in Physical Education. Safety and protective measures, including training and rehabilitation. Open to juniors and seniors. One course. *Staff*

191, 192. Independent Study. Is open to qualified juniors and seniors. Two courses. *Staff*

Health Education

174. School Health Problems. Includes topics such as physical screening, communicable disease prevention and control, and healthful school environment. One course. *Friedrich*

PHYSICAL EDUCATION FOR WOMEN

Professor Elizabeth C. Bookhout, *Chairman;* Associate Professor Spangler, *Director of Undergraduate Studies;* Associate Professors Eddy, Uhrhane, and Woodyard; Assistant Professors Lloyd, Raynor, and Wray; Instructors Howard, Simpson, White; Part-time Instructor Ourso

Required Physical Education Activity Courses

One year of physical education is required for graduation unless a student is excused for medical reasons. The requirement is met by satisfactory completion of two semesters of physical education activity courses or by an alternate form of activity approved by the Women's Physical Education Department. The work is completed normally in the freshman year. Those who are unable to pass a survival swimming test which is given during Freshman Week must take a swimming course; otherwise, students select activity courses appropriate to their interests and backgrounds. The physical education activity courses and independent activity are conducted on a pass-fail basis.

1-2. Freshman Activity Courses. Each semester students take a full-semester or two half-semester activity courses selected from those listed below. They take a beginning, intermediate, or advanced section according to their skill background. No credit. *Staff*

Full Semester Courses

Modern Dance: Beginning, Intermediate I, Intermediate II, Advanced, and Choreography
Tennis
Water Safety Instructor's Course
Independent Activity (With the approval of the department.)

Half-Semester Courses

Adapted P.E. (for students restricted from full activity)
Archery: Beginning
Badminton: Beginning and Intermediate
Ballet
Basketball: Intermediate and Advanced
Bowling: Beginning and Intermediate
Conditioning Exercises
Equitation: Beginning and Intermediate
Equitation: Advanced Hunt Seat
Fencing: Beginning and Intermediate
First Aid
Folk Dance
Golf: Beginning and Intermediate
Gymnastics: Beginning and Intermediate
Hockey
Jogging
Lacrosse
Movement Awareness
Self Defense
Senior Life Saving
Soccer
Softball
Square Dance
Swimming: Beginning, Intermediate, High Intermediate, Advanced, and Synchronized
Tennis: Beginning, Intermediate, High Intermediate, and Advanced
Track and Field
Trampoline and Floor Exercise
Volleyball
Independent Activity (With the approval of the department.)

Elective Physical Education Activity Courses

61-62. Sophomore Activity Courses. Students may take, as electives, the following activity courses if they are different or more advanced than activity courses taken to fulfill the physical education requirement. Prerequisite: P.E. 1-2. Half-course per year. *Staff*

161-162. Junior and Senior Activity Courses. Students may take, as electives, the following activity courses if they are different or more advanced than activity courses taken previously. Prerequisite: P.E. 1-2. Half-course per year. *Staff*

Elective Activity Courses*

Adapted Physical Education
Badminton: Beginning and Intermediate
Fencing: Beginning and Intermediate
Folk Dance: Philippine, Russian, Balkan, Israeli, and Scandinavian
Golf: Beginning, Intermediate, and Advanced
Gymnastics: Beginning and Intermediate
Modern Dance: Beginning, Intermediate I, Intermediate II, and Advanced
Senior Life Saving
Swimming: Beginning, Intermediate, Advanced, and Synchronized
Tennis: Beginning, Intermediate, High Intermediate, and Advanced
Volleyball
Water Safety Instructor's Course

Non-Credit Activity Courses

151, 152. Non-Credit Elective Activity Courses. Open to upperclass women who have fulfilled the physical education requirement. No credit. *Staff*

Theory Courses in Physical Education

The courses listed in this section are open as electives to undergraduate men and women. The following courses meet distributional requirements in the social science division: P.E. 113D, 114, 130S, 131S, 133, and 195S.

102. Physical Education for Early Childhood. Theory and practice in teaching basic skills, rhythms, and games to young children in grades K-3. Half-course. *Staff*

103. Physical Education for the Intermediate Grades. Planning, organizing, and conducting physical education programs for children in grades 4-9. Half-course. *Staff*

105. Group Leadership in Recreation. Interaction and group dynamics. Open to sophomores, juniors, and seniors. One course. *Simpson*

106. Methods and Materials in Recreation. Development of leadership skills in crafts, rhythmic activities, social recreation, and dramatics. Laboratory work includes experience with an organized recreational group. Open to sophomores, juniors, and seniors. One course. *Simpson*

113D. Anatomical Bases for Human Movement. The function of bones, joints, and muscles in human movement. One course. *Bookhout*

114. Kinesiology. A study of muscle function and analysis of human movement. Prerequisite: Physical Education 113D or Zoology 53. One course. *Bookhout*

117. Adapted Physical Education. Analysis of exercises and activities appropriate to individual needs. Theory and practice in planning and conducting adapted programs. Half-course. *Bookhout*

*The maximum amount of credit which a student may earn for elective physical education activity courses is 1 full course.

130S, 131S, 133S. History of Dance. Emphasis on form, structure, and content related to culture of eras. P.E. 130S, Prehistoric to Duncan; P.E. 131S, Duncan to Cunningham; P.E. 133S, Cunningham to the present. Three courses. *Wray or White*

132. Creative Movement for Children. Basic theory and experience in creative movement for grades K-12. The study of the classification and elements of movement with observation and practical experiences with children. Recommended for those students interested in dance, music, recreation, and elementary and secondary teaching. One course. *Wray*

135, 136. Principles of Contemporary Dance Composition. Prerequisite: Beginning Modern Dance and Intermediate Modern Dance I or permission of instructor. Two courses. *White or Wray*

139. Movement Connotations. Theories and forms of human movement with emphasis on sensory awareness and non-verbal communication. One course. *Wray*

191, 192. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. Two courses. *Staff*

195S. Recent Research in Physical Education and Related Fields. One course. *Staff*

HEALTH EDUCATION COURSES

All of the following courses meet distributional requirements in social science except H.E. 134.

134. School Health. Organization of the school health program; basic health problems in school; methods and materials for teaching about health. Primarily designed for students preparing to teach in elementary or secondary schools. Juniors and seniors only. Half-course. *Uhrhane*

137S. Health in Developing Countries. Health conditions, practices, and problems interacting with economics, productivity, and progress of emerging nations with some emphasis on African states. One course. *Uhrhane*

138S. Health Problems in Metropolitan Areas. Relationships between urbanization and health illustrated by environmental hazards, population motion, food distribution, housing, city planning, poverty, drug usage, and consumer awareness. One course. *Uhrhane*

140S. Gereology and Health. Health implications in relationships within families and between generations, in the changing role of the elderly in modern society, in retirement, and in extended leisure time; illness, disability, and medical care. One course. *Uhrhane*

170T. Special Health Problems. Problems and issues in health affairs selected by students for concentrated study. One course. *Uhrhane*

191, 192, 193, 194. Independent Study. Prerequisite: consent of instructor. One course each. *Uhrhane*

History

Professor Durden, *Chairman;* Professor Hollyday, *Director of Undergraduate Studies;* Professors Acomb, Alden, Colton, Ferguson, Holley, Lerner, Parker, Preston, Ropp, A. Scott, W. Scott, Silberman, TePaske, Watson, and Young; As-

sociate Professors Brieger, Cahow, Cell, Chafe, Davis, Hartwig, Mauskopf, M. Miller, S. Nathans, and Witt; Assistant Professors Bergquist, Calkins, Dirlik, Gavins, and J. Scott; Instructor Rolf; Lecturers Gunsburg, Lindley, E. Nathans, Y. Miller; Adjunct Assistant Professor Goodwyn; Visiting Professor Thorpe; Visiting Associate Professor Gough; Part-time Instructors Conrad and Evans

PREREQUISITE COURSES

Majors take a year sequence of 2 prerequisite courses in history (21-22, 21S-22S, 53-54, 91-92, 175D-176D), beginning either semester. Other students are urged, but not required, to take two semesters of prerequisite courses before proceeding to advanced-level courses. Additional courses may be chosen from this group as electives or part of the departmental major.

21. Europe to the Eighteenth Century. Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Staff*

21S. Europe to the Eighteenth Century. A seminar version of History 21. One course. *Staff*

22. Europe From the Eighteenth Century. Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Staff*

22S. Europe From the Eighteenth Century. A seminar version of History 22. One course. *Staff*

53. Greek History. (Listed also as Classical Studies 53.) One course. *Rigsby*

54. Roman History. (Listed also as Classical Studies 54.) One course. *Rigsby*

91. The Development of American Democracy to 1865. A study of the trends vital to an understanding of the United States today. The main theme is the development of American Democracy. Problems of foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals are considered in relation to this main theme. One course. *Staff*

92. The Development of American Democracy, 1865 to the Present. A continuation of History 91 with emphasis upon the emergence of contemporary problems in the United States. One course. *Staff*

175D, 176D. From Tradition to Revolution. Compares social, political, and economic changes in African countries, India, Pakistan, Bangla Desh, China, and Japan. Emphasizes social and political organizations, belief systems, and environmental settings. Two courses. *Calkins, Dirlik, and Hartwig*

OTHER UNDERGRADUATE COURSES

101, 102. Introduction to the Civilizations of Southern Asia. (Also listed as Interdisciplinary Course 101, 102.) One course. *Calkins*

103. The Economic, Social and Political Institutions of Europe, 1250-1600. One course. *Witt*

104. The Intellectual Life of Europe, 1250-1600. One course. *Witt*

105, 106. Political and Constitutional History of England. The origins and evolution of the principal institutions of the English government, related to their setting in a changing society. Two courses. *J. Scott*

107, 108. Social and Cultural History of England. English history from the fourteenth century to the present time in an effort to arrive at a synthesis of ideas, social conditions, and political events and thus provide a background for the study of English literature. Two courses. *Ferguson*

113, 114. The United States from the 1890's to World War II. First semester to 1920; second semester through the New Deal. Two courses. *Watson*

115, 116. History of Africa. Social, political, and economic development in tropical Africa. First semester: cultural background and pre-colonial history. Second semester: colonial and contemporary times. Two courses. *Hartwig*

117, 118. European Imperialism and Colonialism. The age of discovery, the new imperialism, and modernization of post-colonial societies. Two courses. *Cell*

119, 120. History of Socialism and Communism. The origins and development of socialist and communist movements from pre-Marxian times to the present. Two courses. *Lerner*

121, 122. Diplomatic History of the United States. Emphasis on those factors, foreign and domestic, that have shaped the foreign policies of the Republic. Two courses. *Davis*

123, 124. City and Frontier in United States History. The westward movement and the progress of urbanization with attention to the social and political consequences. Two courses. *A. Scott*

125. The Athenian Empire. (Also listed as Classical Studies 134.) One course. *Staff*

126. Alexander the Great. (Also listed as Classical Studies 135.) One course. *Staff*

128. The United States and Latin America. Economic, cultural, political, and diplomatic relationships in the twentieth century. One course. *Bergquist*

129, 130. Society and Government in the United States 1789-1877. Two courses. *S. Nathans*

131. Mexico and the Caribbean from the Wars of Independence to the Present. One course. *TePaske*

132. Comparative Development of Major South American Nations, 1850 to the Present. Brazil, Argentina, Chile, and Colombia, their separate evolutionary paths and approaches to economic and social crises. One course. *Bergquist*

133. Medieval Europe, 300-1000 A.D. One course. *Young*

134. Medieval Europe, 1000-1400 A.D. One course. *Young*

135, 136. Europe in the Twentieth Century. Political, economic, and intellectual developments in Europe since 1900. First semester to 1933; second semester to the present day. Two courses. *Colton*

137, 138. Foreign Relations of the European Powers. European diplomacy and Europe's position in the world since 1870, with an introductory survey of diplomatic institutions since the Renaissance. Two courses. *W. Scott*

139, 140. Nineteenth Century Europe. With special attention to Germany and Austria-Hungary, this course emphasizes the development of European nationalism and the clash of freedom and authority. Two courses. *Hollyday*

141. Man and Society in Traditional China. Chinese thought and institutions from earliest times to the nineteenth century. One course. *Dirlik*

142. The Roots of the Revolution. Nineteenth and twentieth century China. One course. *Dirlik*

143, 144. History of Modern Japan. Japan from 1600 to the present; the transition from the traditional to the modern state. Two courses.

145, 146. Afro-American History. The Black experience in America from slavery to the present. (Also listed as Black Studies 83, 84.) Two courses. *Thorpe*

147. History of India to 1707. Early development, classical Hindu civilization, the impact of Islam, first modern contacts. One course. *Calkins*

148. History of India and Pakistan, 1707 to the Present. Decay of the Mughal Empire, social and economic impact of Western rule, development of nationalism and independence. One course. *Calkins*

149. Military History. War, politics, and technology. One course. *Ropp*

150S. The Concept of the Democratic Faith. One course. *Cahow*

151. Modern Technology. Emphasis on Western technology in the nineteenth and twentieth centuries as related to political, economic, and scientific trends. One course. *Ropp*

152. Modern Mexico. A problem-oriented interdisciplinary approach based upon literature, history, the fine arts, and films. Readings in English or Spanish. (Also listed as Spanish 152.) One course. *Fein and TePaske*

153S. The Insurgent South. Reconstruction, Populism, and the civil rights era, each approached from a multidisciplinary perspective. (Also listed as Interdisciplinary Course 153S.) One course. *Goodwyn*

154. Medieval England. One course. *Young*

155, 156. Modern Latin America. First semester: nineteenth century; second semester: twentieth century. Two courses. *Bergquist*

157, 158. The Rise of Modern Science. The development of science and medicine, with attention to cultural and social influences upon science. First semester: through Newton. Second semester: eighteenth to twentieth centuries. Two courses. *Mauskopf*

160. The United States from the New Deal to the Present. One course. *Chafe*

161, 162. History of Modern Russia. First semester: origins of Kievan Russia in the ninth century through the reign of Catherine the Great (1762-1796), concentrating on the formation of the imperial state, class elites, and psychological interpretations of the rulers. Second semester: nineteenth and early twentieth century to the death of Lenin, stressing the opposition movements in society. Two courses. *M. Miller*

163, 164. Reform and Politics in Nineteenth Century United States. First semester: the coming of the Civil War, with emphasis on the reform movements of the Jackson era, the anti-slavery crusade, and national politics to 1861. Second semester: reform and politics from the war and Reconstruction era to the Farmers Revolt of the 1890's. Two courses. *Durden*

167, 168. Modern European Intellectual and Cultural History. Leading European thinkers from the Enlightenment to the present. Two courses. *Parker*

169, 170. The Search for the American Woman: A New Approach to Social History. Prerequisite: History 91, 92. Two courses. *A. Scott*

173, 174. History of Spain and the Spanish Empire from Late Medieval Times to the Present. First semester: unification and development of the empire in Europe and America, emphasizing colonial institutions and culture, 1450-1670. Second semester: fall of the empire and modern development through the Franco Regime. Two courses. *TePaske*

177. China since 1949: The Peoples' Republic. The Chinese path to communism and the communist transformation of Chinese society. One course. *Dirlik*

178. Diplomacy of the United States Since 1939. One course. *Davis*

181, 182. Development of Modern Medicine. Two courses. *Brieger*

183S. Canada from the French Settlement. Problems in the development of Canada and its provinces. One course. *Preston or Gough*

184. Canada: Problems and Issues of an Advanced Industrial Society. (Also listed as Interdisciplinary Course 184.) One course. *Preston and Visiting Lecturers*

188. History of the Middle East, 1789 to the Present. The decline of the multinational Ottoman Empire and the emergence of Turkish, Arab, and Jewish national states after World War I. One course. *Y. Miller*

199. The Changing South. (Also listed as Interdisciplinary Course 199.) One course. *Staff*

For Upperclassmen and Graduates

Students may receive credit for either semester of a hyphenated course at the 200-level without taking the other semester if they obtain written permission from the instructor.

201, 202. Aspects of Change in Prerevolutionary Russia. Origin and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of the labor movement. Two courses. *M. Miller*

209, 210. Selected Topics in Afro-American History, 1619-Present. Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. (Also listed as Black Studies 209, 210.) Two courses. *Thorpe*

212. Recent Interpretations of United States History. A course designed to encourage a critical evaluation of major issues in United States history through examination of recent interpretations of key problems. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) One course. *Watson and Staff*

215-216. The Diplomatic History of the United States. (Not open to undergraduates who have had History 121-122.) Two courses. *Davis*

221. Problems in the Economic and Social History of Europe, 1200-1700. One course. *Witt*

222. Problems in European Intellectual History, 1250-1550. One course. *Witt*

223S, 224S. The Old Regime, the Enlightenment, and the French Revolution. Political, social, and intellectual trends in seventeenth and eighteenth

century Europe, with emphasis on France and the French Revolution. Two courses. *Acomb*

227-228. Recent United States History: Major Political and Social Movements. Two courses. *Chafe*

229. Recent Interpretations of Modern European History. A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern European history. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) One course. *Colton or Parker*

231S, 232S. Problems in the History of Spain and the Spanish Empire. Two courses. *TePaske*

237S. Europe in the Early Middle Ages. One course. *Young*

238S. Europe in the High Middle Ages. One course. *Young*

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and musical and artistic traditions. One course. *Hartwig*

241-242. Modernization and Revolution in China. Two courses. *Dirlik*

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation, with special emphasis on social and economic change. One course. *Calkins*

248. History of Modern India and Pakistan, 1857 to the Present. One course. *Calkins*

249-250. Social and Intellectual History of the United States. The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. Two courses. *Holley*

253-254. Modern European Intellectual History. Two courses. *Parker*

255S-256S. Problems in African History. Two courses. *Hartwig*

260. Economic History of Japan. (Also listed as Economics 232.) One course. *Bronfenbrenner*

261-262. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and politics of the Soviet state. Two courses. *Lerner*

263-264. American Colonial History and the Revolution, 1607-1789. The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. Two courses. *Alden*

265S, 266S. Problems in Modern Latin American History. Two courses. *Bergquist*

267S-268S. From Medieval to Early Modern England. The intellectual, social, and political problems of transition to modern England, with special emphasis on the English Renaissance. Two courses. *Ferguson*

269-270. British History, Seventeenth Century to the Present. Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class consciousness, Victorianism, and the impact of war in the twentieth century. Two courses. *Cell*

273, 274. Topics in the History of Science. Critical stages in the evolution of scientific thought. Two courses. *Mauskopf*

277. The Coming of the Civil War in the United States, 1820-1861. One course. *Durden*

278. The Civil War in the United States and Its Aftermath, 1861-1900. One course. *Durden*

279. Oral History. Techniques applied to racial attitudes and problems in the United States. One course. *Goodwyn*

280. Historiography. Great historians since Herodotus and an examination of recent twentieth century trends. One course. *Parker*

283-284. Political and Social Change in the United States, 1789-1880. Two courses. *S. Nathans*

287-288. History of Modern Japan. The political, economic, and social development of Japan since 1750; factors contributing to Japan's emergence as a modern state. Two courses. *Staff*

297. The British Empire in the Nineteenth Century (from 1783). The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. One course. *Preston or Gough*

298. The Commonwealth in the Twentieth Century. The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anti-colonialism. One course. *Preston*

SMALL-GROUP LEARNING EXPERIENCES

(For discussion sections, see History 175D, 176D.)

Tutorial

189T, 190T. Tutorial in History. Two courses. *Staff*

Independent Study

Independent study is usually undertaken by students concurrently with a course or with an instructor with whom they have had a course. Students should submit to the instructor in writing a detailed description of intent in the study. Both the instructor's consent and approval of the Director of Undergraduate Studies are required for enrollment.

191, 192. Independent Study. One or two courses each. *Staff*

Undergraduate Seminars

(See also History 21S, 22S, 150S, 153S, 183S, 199S.)

165S-166S. Seminar in Selected Topics. Course content determined by instructor; permission of instructor is required. Two courses. *Staff*

The following seminars offer opportunities for reading and historical investigation in significant problems. Juniors as well as seniors may apply for admission to these courses and are urged to do so if they expect to be candidates for graduation with distinction in history or if they expect to practice-teach in their senior year. All seminars are open to majors and non-majors.

195A-196A. Renaissance Intellectual History. Studies in the transformation of European thought between 1300 and 1600. Two courses. *Witt*

195B-196B. Twentieth Century Europe. Two courses. *Colton*

195C-196C. Problems in the Social and Intellectual History of the United States. Two courses. *Holley or Lindley*

195D-196D. Problems in Twentieth Century United States History. Two courses. *Chafe or Watson*

195E-196E. The Age of the American Revolution. Two courses.

195F. The Coming of the Civil War in the United States, 1820-1861. One course. *Durden*

196F. The Civil War in the United States and Its Aftermath, 1861-1900. One course. *Durden*

195G-196G. Nationalism and Communism in the Far East. Two courses. *Dirlik*

195H-196H. From Rural to Urban Society in the United States. Two courses. *A. Scott*

195I. The Emergence of Germany, 1815-1871. One course. *Hollyday*

196I. The German Empire and Europe, 1871-1918. One course. *Hollyday*

195J-196J. History of International Socialism to the First World War. Evolution of socialist thought from early nineteenth century Utopian theory through Marxist and anarchist ideologies; the relationship of socialist parties and leaders to the first and second Internationals. Two courses. *M. Miller*

195K-196K. Social Change in Modern Britain. Two courses. *Cell*

195L. Causes of Revolution: Search for a Model. One course. *Cell*

195M-196M. Europe and the World since 1914. Two courses. *W. Scott*

195N-196N. The English Renaissance. Two courses. *Ferguson*

195P-196P. Social and Political Problems in English History, 1680-1815. Two courses. *J. Scott*

195R. The Age of Newton. One course. *Mauskopf*

196R. Science and Society, 1775-1875. One course. *Mauskopf*

195S-196S. Processes of Development in Modern Japan, 1800 to the Present. Two courses.

195T-196T. Problems in the History of Russia Before 1917. Two courses. *Lerner or M. Miller*

195U-196U. Social Conflict and Political Change in the United States, 1789-1860. Two courses. *S. Nathans*

195V-196V. Problems in Afro-American History. (Also listed as Black Studies 195-196.) Two courses. *Gavins*

195W. Studies in Modern Indian History. One course. *Calkins*

196W. Pre-Modern Imperial Systems. Compares components of the political, social, and economic structures of pre-modern bureaucratic empires, stressing seventeenth and eighteenth century India, China, and Iran. One course. *Calkins*

195X-196X. Problems in Latin American History. Two courses. *Bergquist or TePaske*

195Y-196Y. Issues in the History of Tropical Africa. Two courses. *Hartwig*

195Z-196Z. Problems in Recent United States Diplomatic History. Two courses. *Davis*

197S-198S. Senior Honors Seminar. A course designed to introduce qualified students to advanced methods of historical research and writing and to the appraisal of critical historical issues. Open only to seniors, but not restricted to candidates for Graduation with Distinction. This course, when taken by a history major, is accompanied by 2 courses of 195-196 seminars or at the 200 level. In unusual circumstances, with permission of the instructor, coordinator of the Senior Honors Seminar, and Director of Undergraduate Studies, 191-192 may replace the 2 courses of 195-196 seminars or at the 200 level. Two courses. *Staff*

Upperclassmen-Graduate Seminars

See History 223S, 224S, 231S, 232S, 237S, 238S, 255S, 256S, 265S, 266S, 267S, and 268S.

DEPARTMENTAL MAJOR

Prerequisites. A year sequence of 2 prerequisite courses in history (21-22, 21S-22S, 53-54, 91-92, 175D-176D), beginning either semester.

Major Requirements. Students desiring to take a major in history elect, in addition to the 2 prerequisite courses, 6 courses in the department, including 2 courses in an undergraduate seminar (195-196, 197-198) or on the 200 level. They are urged to register for 2 consecutive courses at this level, but may take 2 single semester courses with permission of both instructors. Students wishing to take advanced courses in the history of the United States are advised to elect History 91-92.

Foreign Languages. Majors interested in a particular area of study would benefit from knowledge of the language of that area. Majors who contemplate graduate work are reminded of the requirement of a reading knowledge of one or two foreign languages.

Majors Planning to Teach. Majors who plan to teach in secondary schools should consult the Education Department. Rising juniors who intend to practice teach in the senior year should take their 195-196 or 197-198 seminar or 200-level courses as juniors. Two courses, History 229 in the fall and 212 in the spring, are scheduled in accelerated sessions to fit the half semester the student is on campus during the semester he does practice teaching.

Ancient History. For additional courses in ancient history which may be taken for credit in history, see the history courses listed in the Department of Classical Studies.

Honors. Any student who is qualified (see the section on Honors in this *Bulletin* for general requirements) may undertake work leading to a degree with distinction in history by presenting himself to his history faculty adviser as a candidate. Usually, honors work involves participation in one of the 195-196 seminars during the junior year and selection for the Senior Honors Seminar in the senior year. Further information is available at the History Department office, 236 Allen or 102 West Duke Building.

House Courses

See page 38 for information about house courses. Since each house course is offered only one time they are not listed or described here.

Interdisciplinary Courses

The following are cooperative courses offered by the departments concerned. Where a department accepts the course for the major, the same number is used as a departmental offering.

101, 102. Introduction to the Civilizations of Southern Asia. Hindu, Islamic, and Buddhist foundations, impact of the West, and emergence of the modern nation-states of Southern Asia. The first semester will analyze traditional Hindu civilization and Islamic impact on Southern Asia. The second semester will examine Western influences and the development of modern societies and states in Southern Asia. (See Departments of Anthropology, History, and Political Science.) Two courses. *Apte, Braibanti, Calkins, Di Bona, Fox, and Lawrence*

104. Man and the Marine Environment. For description see Marine Sciences. One course. *Staff*

153S. The Insurgent South. Reconstruction, Populism, and the civil rights era, each approached from a multidisciplinary perspective. (Also listed as History 153S.) One course. *Goodwyn*

156. The Contemporary Woman: History and Prospects. A survey of the status of women with consideration of cultural, sociological, psychological, and political aspects. (Also listed as Sociology 156.) Half-course. *Friedel, A. Scott, and J. O'Barr*

158. Women and Literature. Small-group discussions of modern women authors including Virginia Woolf, Doris Lessing, and Anais Nin, and of myths of women in literature and society. Nature of course adapted to the interests of students. This course may be used for distributional requirements in humanities. Prerequisite: permission of the instructor. One course. *Staff*

184. Canada: Problems and Issues of an Advanced Industrial Society. Federal-provincial relations, economic development, environmental and resource problems, American economic and cultural influences, bilingualism and biculturalism, international relations and aid, defence, military relations with the United States, and the "quest for identity." Some seminars, conducted by visiting Canadian specialists. (See Departments of History, Economics, Political Science, and Sociology.) One course. *Preston and Visiting Lecturers*

199. The Changing South. A survey of the geography, demography, economics, politics, and culture of the South. (See the Departments of Anthropology, Economics, History, and Political Science.) One course. *Staff*

Italian

For courses offered in Italian, see *Romance Languages.*

Judaic Studies—Cooperative Program at Duke and UNC-Chapel Hill

Associate Professor Meyers (Religion), *Director;* Associate Professors Bailey (Divinity) and Wintermute (Religion); Assistant Professors Alt (Germanic Languages and Literatures) and Bland (Religion)

A program in Judaic studies may be taken as part of a major in religion, as a supplement to any other major, or under Program II.

For a description of the following courses consult the listings under the specified departments.

German

Y171. Yiddish Literature in Translation. *Alt*
Y181.1-Y181.2. Yiddish. *Alt*

Religion

50. The Old Testament. *Staff*
104. The Prophets of the Old Testament. *Wintermute*
105. Theology of the Old Testament. *Wintermute*
131D. Principles of Archaeological Investigation. *Meyers*
132D. Palestine in Late Antiquity. *Meyers*
133. Foundations of Post-Biblical Judaism. *Meyers*
134. Jewish Mysticism. *Bland*
135. Jewish Religious Thought. *Bland*
136. Contemporary Jewish Thought. *Meyers*
137. Structure and Theology of Jewish Prayer. *Bland*
139. Modern Hebrew. *Staff*
195C, 196C. Junior-Senior Seminars: Judaic Studies. *Staff*
115-116. (Divinity School) Introduction to Biblical Hebrew. *Bailey*
207, 208. (Divinity School) Second Hebrew. *Staff*
220. Third Hebrew. *Staff*
221. Readings in Hebrew Biblical Commentaries. *Bland*
238. Jewish Responses to Christianity. *Bland*
244. The Archaeology of Palestine in Hellenistic-Roman Times. *Meyers*

Opportunities for independent study are offered in the Department of Religion under 191, 192, 193, 194. Procedures for registration and applications are available in 118 Gray Building.

Special attention is directed to those courses in New Testament which are relevant to the study of Rabbinic Judaism, i.e., Religion 106, 107, 108, 111, and 145 and to the appropriate courses at the University of North Carolina-Chapel Hill.

Latin

For courses offered in Latin, see *Classical Studies*.

Linguistics

The courses in linguistics may be taken as electives by advanced students. Certain courses serve as related work in several departments. No major is offered in linguistics. Students interested in the study of language as part of their undergraduate program or as a preparation for graduate work in linguistics should consult the instructors of the courses listed below. For descriptions of the following courses consult the listings under the specified department.

Anthropology

107. Introduction to Linguistics. *Apte, Butters, Casson, or Hull*
119. Language, Culture, and Society. *Apte, Casson, or Rosen*
120. Comparative Language. *LaBarre*
210. Linguistic Anthropology: Theory. *Apte or Casson*
211. Linguistic Anthropology: Ethnography of Communication. *Apte or Casson*
259. Linguistic Anthropology: Language Acquisition. *Casson*

Dutch

181, 182. Dutch. *Stern*

English

108. Development of the English Language. *Butters*
109. Modern English Grammar. *Butters*
207. Old English Grammar and Readings. *Nygard*
208. History of the English Language. *Nygard*
209. Present-Day English. *Butters, Nygard, or Reiss*

French

210. The Structure of French. *Hull*
219. Old French Literature. *Vincent*
224. History of the French Language. *Hull*

German

205, 206. Middle High German. *Stern*
216. History of the German Language. *Stern*
219. Applied Linguistics. *Stern*

Philosophy

103. Symbolic Logic. *Staff*
109. Philosophy of Language. *Welsh*

Spanish

257. Old Spanish Language. *Davis*

Yiddish

181, 182. Elementary Yiddish. *Alt*

Management Sciences

Professor Keller, *Chairman;* Professor Dickens, *Director of Undergraduate Studies;* Professors Baligh, Cohen, Joerg, Laughhunn, Lewin, and Peterson; Visiting Professor Lewellen; Adjunct Professor Porter; Associate Professors Abdel-khalik, Baker, Battle, Burton, Dellinger, and Morse; Assistant Professors Aldrich, Damon, Kuhn, Magat, Maier, Taylor, Vander Weide, and Zalkind; Part-time Instructors Keel and Reinhart

The courses offered by the Department of Management Sciences stress conceptual understanding of, and analytical reasoning related to, problems of modern management, and the relationship between the performance of complex organizations and the society in which they operate.

50. Elementary Theory of Economic Enterprise. Analysis of the internal resource allocation problem of the enterprise, of market structures, and the relationship between the two. Topics include marginal analysis, theories of competitive market structures, and introduction to special problems of finance, marketing, and production. Prerequisite or corequisite: Mathematics 32. One course.

50P. Preceptorial. Elective preceptorial for students enrolled in Management Sciences 50. *Staff*

55. Quantitative Analysis for Management. Some mathematical theory and techniques used in the study of economic enterprise, such as classical optimization, optimization under constraints, introductory matrix and linear

algebra, basic probability theory, special probability distributions. Not open to students who have had Economics 134, Mathematics 104, or Mathematics 135. Prerequisite: Mathematics 31. One course.

100. Introduction to Financial Accounting. Conceptual framework of external reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economic terms and the interpretation of published financial statements. Prerequisite: sophomore standing. One course.

110. Statistics for Management Decisions. Fundamentals of classical and Bayesian statistical analysis and elementary decision theory. Application of statistical analysis to decision problems. Topics include a review of sampling distributions, point and interval estimation, hypothesis testing, decision theory, and regression and correlation analysis (including computer routines). Not open to students who have had Economics 138 or Mathematics 136. Prerequisites: Management Sciences 55, Mathematics 135, or Economics 134. One course.

111. Investment Management. Problems of selecting a portfolio of investments emphasizing the economics of the markets and the tools of analysis. Prerequisites: Management Sciences 50 or equivalent, or permission of the instructor. One course.

120. Organization Theory. Introduction to recent theories of, and research on, the structure and behavior of complex organizations, with special reference to business firms. Topics to be covered include: rationality, authority, bureaucracy, and other concepts; power, decision-making, informal organization, organization change, and other internal process phenomena; effects of technology, culture, and other environmental influences; brief consideration of organization design. Prerequisites: Management Sciences 50, 55, or equivalent. One course.

125. Management of Public Enterprises. Resource allocation within and among major public sector projects in a mixed economy. Emphasis on nonmarket decision-making for governmental agencies and other nonprofit organizations. Prerequisite: junior standing or Management Sciences 50 or Economics 52. One course.

130. Information Systems. An analysis of the data needed for economic decisions relating to business enterprises and of the systems used in accumulating, analyzing, interpreting, and presenting the data to various users. Financial reporting to external users and managerial use of information for decision-making are stressed. Prerequisites: Management Sciences 50, 55, or equivalent. One course.

140. Operations Research. Introduction to the use of mathematical models in the analysis of decision problems. Topics include mathematical programming, game theory, dynamic programming, queuing theory, simulation, and inventory models. Use of electronic computer will be included. Prerequisites: Management Sciences 50, 55, or equivalent, and computer programming competence. One course.

191, 192. Independent Study. Directed reading and research. Approval of the instructor and the Director of Undergraduate Studies required.

193, 194. Independent Study. Same as 191, 192 but for seniors.

210S. Intermediate Theory of Economic Enterprise. Introduction to competitive market strategies and cooperating decisions and analysis of the

efficiency and equilibrium of market structures. Emphasis is on the effects of the economic environment on the decision of the enterprise, and conversely. Prerequisites: Management Sciences 120, 130, and 140. One course.

211S. Finance. An analysis of the problems of management of the financial affairs of the firm with particular attention to the long-term capital needs and the development of an optimal capital structure. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

213S. Marketing. An examination of public policy and the marketing behavior of private enterprise and the creation of a marketing program for the firm. Prerequisites: Management Sciences 110, 120, 130, and 140, or permission. One course.

215S. Production. An economic and social analysis of the problems of designing a production system for an organization, of operating within the constraints of a given production system, and of the interactions between a production system and other components of the organization and with society. Prerequisites: Management Sciences 110, 120, 130, and 140, or permission. One course.

220S. Advanced Organization Theory. Continuation of Management Sciences 120S, but with extension to nonmarket organizations such as labor unions, universities, hospitals, and governmental units. Special emphasis will be placed on the following topics: development and testing of mathematical models of organization; optimum organization design; treatment of organization as political coalitions, using game theoretic concepts; consideration of the social choice questions. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

230S. Controllership. An analysis of the use of accounting information in the planning, control, and decision-making process in the business enterprise. Topics include methods of cost accumulation, development of standards, the basic patterns of cost behavior, budgeting techniques for aiding long-range planning and the making of specific decisions. Prerequisites: Management Sciences 110, 120, and 130, or permission. One course.

231S. Financial Accounting. An in-depth analysis of the requirements of outsiders (investors, auditors, unions, and governments) for information about the status and operations of firms and a framework for disclosure of the relevant data. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

232S. Internal Control and Auditing. An analysis of the accounting control system and the independent auditor's examination of that system and other evidence as a basis for expressing an opinion on a client's financial statements. Topics include basic audit objectives, standards, ethics, terminology, procedures, and reports. Prerequisites: Management Sciences 110 and 231, or permission. One course.

233S. Federal Income Taxation. A study of the principles of federal income tax laws as related to corporations and individuals. Tax planning and the effect of tax law on business decisions will be emphasized. Prerequisite: Management Sciences 231 or permission. One course.

234, 235, 236. CPA Preparation. Intensive preparation for the Certified Public Accountant's Examination, including fundamental principles of commercial law, advanced accounting problems, and accounting theory. Pre-

requisites: Management Sciences 230 and 231 or permission. (Those who do not wish credit may take Management Sciences 234, 236 for $40 per semester.) One course each.

240S. Advanced Operations Research. The application of operations research methodology to real world problems. Special emphasis will be placed on problem formulation, model-building, model validation and evaluation, sensitivity analysis, interpretation of results, and implementation. Prerequisites: Management Sciences 120, 130, and 140, or permission. One course.

241S. Decision Theory. A study of the structure of decision problems arising in the operation of an organization, alternative decision criteria, and the development of decision rules for rational behavior. Included will be an investigation of decision-making under certainty risk, and uncertainty, decision-making in competitive situations, and the cost and value of information. Prerequisites: Management Sciences 110, 120, 130, and 140, or permission. One course.

289S. Research Methodology. Philosophy and logic of research in the social sciences (nature of explanation; normative and positive theories; functional, rational, and conflict models); theory development and model construction (including attention to testability of inferences, problems of identification, etc.); experimental design, data collection, and data analysis (including attention to problems of uncontrolled experiments, sampling theory, comparison of case studies, survey research, field experiments, use of published data). Prerequisites for management sciences majors: Management Sciences 120, 130, and 140. For nonbusiness majors: one semester of statistics, computer programming, one upper-level mathematics course, and at least 3 social science courses beyond the introductory level. One course.

DEPARTMENTAL MAJOR

The Department of Management Sciences offers a major in two areas—accounting and management science. Each major requires that the student take the same prerequisite courses.

Prerequisite and Corequisites Required of All Majors in the Department. Mathematics 31, 32.

Required Courses. Management Science 50, 55, 110, 120, 130, 140 and 210, plus one elective from 200-level courses. The elective work required for major in accounting includes Management Sciences 230, 231, 232, and 233.

A student may specialize in public or industrial accounting in his junior and senior years. The following sequence of courses is recommended as preparation for certification as a professional accountant:

Freshman Year
- Mathematics 31 and 32, Introductory Mathematical Analysis
- Management Sciences 50, Elementary Theory of Economic Enterprise
- Computer Science 51 or develop competence in computer operations

Sophomore Year
- Management Sciences 55, Quantitative Analysis for Business
- Management Sciences 110, Statistics for Management Decisions
- Management Sciences 120, Organization Theory
- Management Sciences 130, Information Systems

Junior Year
- Management Sciences 140, Operations Research
- Management Sciences 210, Intermediate Theory of Economic Enterprise
- Management Sciences 230, Controllership
- Management Sciences 231, Financial Accounting

Senior Year

Management Sciences 232, Internal Control and Auditing
Management Sciences 233, Federal Income Taxation
Management Sciences 234, 235, and 236, CPA Preparation

Marine Sciences—The University Program

Professor Costlow, *Director;* Professors Bookhout (Zoology), Johnson* (Botany), and Pilkey* (Geology); Associate Professors Barber (Botany and Zoology) and Searles* (Botany); Assistant Professors Baier (Chemistry), Blankley (Botany), Forward (Zoology), Gutknecht (Physiology), Sullivan (Biochemistry), and Sutherland (Zoology); Associate J. Bonaventura (Biochemistry); Research Associate C. Bonaventura (Biochemistry)

The interdisciplinary program in the marine sciences makes it possible for qualified juniors and seniors to live and study at the Duke University Marine Laboratory, Beaufort, North Carolina, during the spring semester. The program consists of 2 courses (104 and 150, 169 or 220) and one or two seminars, in addition to independent research. A student may continue study at the Marine Laboratory during the summer either by participating in advanced courses or by continuing independent studies initiated during the spring term.

Applications are to be submitted by October 7 to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516, and should include two letters of recommendation, one of which must be from the director of undergraduate studies of the student's major department. A current transcript is also required. The review committee will be composed of the Director of the Laboratory and the directors of undergraduate studies of the participating departments. Students will be notified of the action of the committee prior to registration for the spring semester.

SPRING COURSES AT BEAUFORT

104. Man and the Marine Environment. Economic, legal, medical, political, social, and scientific viewpoints on the extent to which modern society has affected the marine environment with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Prerequisites: permission of instructor and director of undergraduate studies of student's major department. (Listed as Interdisciplinary Course 104.) One course. *Costlow and Staff*

150L. Physiology of Marine Animals. Comparative physiology including special ecological and behavioral adaptations. Lectures and laboratories. A student may not receive credit for both Zoology 150L and 250L. Prerequisites: introductory biology and chemistry; consent of instructor and director of undergraduate studies of student's major department. (Listed as Zoology 150L.) One course. *Forward*

169L. The Marine Environment. The interrelationships of the geological, chemical and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisites: introductory chemistry and consent of instructor and director of undergraduate studies. (Listed as Botany 169, Geology 169, and Zoology 169.) One course. *Sutherland*

192T. Independent Study. For senior and junior majors with permission of the director of undergraduate studies and the supervising instructor. (Listed

*In residence during summer only.

as Botany 192T, Geology 192, and Zoology 192T.) One and one-half courses. *Staff*

220. Adaptations of Organisms to the Marine Environment. An introduction to basic concepts of biochemistry and to variables in the marine environment which evoke adaptive responses. Specific adaptations at the molecular level are considered and the general topic of biological fitness is discussed from a biochemical viewpoint. Laboratory experiments utilize many basic methods of biochemical analysis. The course is designed to stimulate interest in the molecular basis of adaptation and to give participants greater insight into the unsolved problems in this area. Prerequisites: basic biology and chemistry and permission of the instructors. (Listed as Biochemistry 220.) One course. *C. Bonaventura and J. Bonaventura*

296S. Seminar. Topics, instructors, and course credits announced each semester. (Listed as Zoology 296S.) *Staff*

SUMMER COURSES AT BEAUFORT

For descriptions of the following summer courses consult the listings under the specified departments or the *Bulletin of the Duke University Marine Laboratory:*

114L. Introduction to Biological Oceanography. (Listed as Zoology 114L.) One and one-half courses. *Staff*

202. Introduction to Comparative Behavior. (Listed as Zoology 202.) One and one-half courses. *Staff*

203. Marine Ecology. (Listed as Zoology 203.) One and one-half courses. *Sutherland*

204. Marine Microbiology. (Listed as Botany 204.) One and one-half courses. *Blankley*

205. Geological Oceanography. (Listed as Geology 205.) One and one-half courses. *Pilkey*

211. Marine Phycology. (Listed as Botany 211.) One and one-half courses. *Searles*

212. Marine Membrane Physiology. (Listed as Physiology 212.) One and one-half courses. *Gutknecht and Staff*

214. Biological Oceanography. (Listed as Botany 214 and Zoology 214.) One and one-half courses. *Barber*

230. Chemical Pollution of Coastal Waters. (Listed as Chemistry 230.) One and one-half courses. *Baier*

240. Chemical Oceanography. (Listed as Chemistry 240.) One and one-half courses. *Baier*

250. Physiological Ecology of Marine Animals. (Listed as Zoology 250.) One and one-half courses. *Forward*

274. Marine Invertebrate Zoology. (Listed as Zoology 274.) One and one-half courses. *Staff*

276. Comparative and Evolutionary Biochemistry. (Listed as Biochemistry 276.) One and one-half courses. *Sullivan*

278. Invertebrate Embryology. (Listed as Zoology 278.) One and one-half courses. *Bookhout*

Mathematics

Professor Warner, *Chairman;* Professor Murray, *Director of Undergraduate Studies;* Instructor Smith, *Supervisor of Freshman Instruction;* Professors Carlitz, Murray, Reed, Shoenfield, and Weisfeld; Visiting Professor Beals; Associate Professors Burdick, Hodel, Kitchen, Kraines, Moore, Scoville, D. Smith and Stackelberg; Adjunct Associate Professor Chandra; Assistant Professors Cantor, Lees, MacKichan, Most, Myers, and O'Fallon; Instructors Ekman, Katz, Lawrence, and L. Smith; Part-time Instructors M. Hodel and Swain

19. Pre-Calculus Mathematics. Selected topics in algebra, trigonometry, and analytic geometry. Students with CEEB achievement scores in mathematics below 530 need this skill course before taking Mathematics 31. Prerequisite: two units of college preparatory mathematics. One course. *Staff*

31, 32. Introductory Calculus. Limits, differentiation, integration, elementary and transcendental functions, sequences, series, Taylor's formula. Prerequisite: three years of college preparatory mathematics. Mathematics 31 is prerequisite to Mathematics 32. Two courses. *Staff*

31P, 32P. Preceptorial. Elective preceptorial for students enrolled in Mathematics 31, 32. *Staff*

31X, 32X. Honors Calculus. Similar to Mathematics 31, 32, but more theoretical. Majors in mathematics as well as others who have Achievement Test Scores of 760-800 are encouraged to enroll. Occasionally these courses will be offered as seminars. Two courses. *Staff*

33, 34. Introductory Calculus with Digital Computation. Introduction to the digital computer, analytical and numerical treatments of limits, differentiation, integration, solution of equations in one variable, elementary transcendental functions, sequences, series, Taylor's formula, applications. Mathematics 33 is prerequisite to Mathematics 34. Two courses. *Staff*

53. Basic Statistics. Statistical concepts involved in making inferences, decisions, and predictions from data. Techniques not emphasized. Not open to students who have had Economics 138 or Psychology 117. One course. *Staff*

101, 102. Linear Algebra and Intermediate Mathematical Analysis. Real and complex vector spaces, linear transformations and matrix representations, similarity of matrices, determinants, quadratic forms, partial differentiation, functions defined implicitly, multiple integrals, infinite series, linear differential equations. Prerequisites: Mathematics 32 for 101, and Mathematics 101 for 102. Two courses. *Staff*

103. Intermediate Calculus. Solid analytic geometry with vectors, partial differentiation, multiple integrals, elementary differential equations, and complex numbers. Prerequisite: Mathematics 32. One course. *Staff*

103P. Preceptorial. Elective preceptorial for students enrolled in Mathematics 103. *Staff*

104. Linear Algebra and Applications. Euclidean n-space, abstract vector spaces, linear transformations and matrix representation, elementary row operations, determinants, eigenvectors and eigenvalues; applications to the solution of ill-conditioned simultaneous systems and differential equations. Prerequisite: Mathematics 103. One course. *Staff*

104P. Preceptorial. Elective preceptorial for students enrolled in Mathematics 104. *Staff*

103X, 104X. Sophomore Honors Calculus. Similar to Mathematics 103, 104, but more theoretical. Students who take 31X, 32X are encouraged to enroll. Students continuing from 103X should take 104X rather than 104. Two courses. *Staff*

111. Applied Mathematical Analysis I. Ordinary differential equations, including linear differential equations of order n; partial linear differential equations with constant coefficients; topics in vector calculus; Fourier series. Not open to students who have had Mathematics 131. Prerequisite: Mathematics 103. One course. *Staff*

112. Applied Mathematical Analysis II. Complex variables, residues, conformal mapping, matrices, Laplace and Fourier Transforms and their applications. Prerequisite: Mathematics 103. One course. *Staff*

126. Introduction to Linear Programming and Game Theory. Fundamental properties of linear programs; linear inequalities and convex sets; primal simplex method, duality; integer programming; two person and matrix games. Prerequisites: Mathematics 32 and 104 or consent of the instructor. One course. *Weisfeld*

128. Number Theory. Divisibility properties of integers; prime numbers; congruences; quadratic reciprocity; number-theoretic functions; simple continued fractions; rational approximations. Prerequisite: Mathematics 32 or permission of the instructor. One course. *Staff*

129. Introduction to Modern Algebra. Elementary theory of groups, rings, and fields; construction of basic number systems. Prerequisite: Mathematics 104. One course. *Staff*

131. Elementary Differential Equations. Solution of differential equations of elementary types; formation and integration of equations arising in applications. Not open to students who have had Mathematics 111. Prerequisite: Mathematics 103. One course. *Staff*

132S. Qualitative Theory of Ordinary Differential Equations. Qualitative behavior of general systems of ordinary differential equations, with application to biological and ecological systems, oscillations in biochemistry, electrical networks, and the theory of deterministic epidemics. Prerequisite: Mathematics 131 or 111 or permission of the instructor. One course. *Cantor*

135, 136. Probability and Statistics. Permutations and combinations, total and compound probability, Bayes' formula, Bernoulli's theorem, discrete distributions, central values, moments and mathematical expectation, law of large numbers, probabilities in continuum, continous distributions, sampling distributions, confidence limits, tests of hypotheses, and analysis of variance. Prerequisites: Mathematics 103 for 135; 135 and 104 for 136. Two courses. *Burdick*

135P, 136P. Preceptorial. Elective preceptorials for students enrolled in Mathematics 135, 136. *Burdick*

139, 140. Advanced Calculus. Differential and integral calculus of functions of several variables; spaces of continuous functions; Fourier series; existence theorems and uniqueness theorems for differential equations; line and surface integrals; Green's theorem and Stokes' theorem; power series and

analytic functions. Prerequisites: Mathematics 104 for 139; and 139 for 140. Two courses. *Staff*

152. List Processing and Data Structures. For a description of this course, see Computer Science 152. One course. *Staff*

161. Numerical Solution of Ordinary Differential Equations. Basic existence and uniqueness considerations; algorithmic procedures for step by step integration; stability theory and its limitations; accuracy analysis and numerical procedures for determining it; analogue methods and their accuracy and stability characteristics. Prerequisite: Mathematics 104. (Also listed as Computer Science 161.) One course. *Murray*

171S. Elementary Topology. Basic set theory; metric spaces; topological spaces; continuity; basic topological properties including compactness and connectedness. Prerequisite: Mathematics 104. One course. *Staff*

181. Complex Analysis. Complex numbers, analytic functions, complex integration, Cauchy's theorem, Taylor and Laurent series, theory of residues, argument and maximum principles, conformal mapping. Prerequisite: Mathematics 104. One course. *Staff*

183. Introduction to Statistical Methods. Emphasis on the classical techniques of hypothesis testing and point and interval estimation, using the binomial, normal, t, F, and chi-square distributions. Prerequisite: Mathematics 32 or consent of the instructor. One course. *Staff*

187. Introduction to Mathematical Logic. Propositional calculus, predicate calculus. Godel completeness theorem, applications to formal number theory, incompleteness theorem, additional topics in proof theory or computability. Prerequisites: Mathematics 104 or Philosophy 103. One course. *Staff*

191, 192. Independent Study. Directed reading and research. Admission by approval of instructor and Director of Undergraduate Studies. Two courses. *Staff*

193, 194. Independent Study. Same as 191, 192, but for seniors. Two courses. *Staff*

196S. Seminar in Mathematical Model Building. Real models, mathematical models, axiom systems as used in model building, deterministic and stochastic models, linear optimization, competition, graphs and networks, growth processes, evaluation of models. Term project: model of a nonmathematical problem. Prerequisite: Mathematics 104. One course. *D. Smith*

197S. Seminar in Mathematics. Primarily intended for juniors and seniors majoring in mathematics. Content of course determined by instructor. Prerequisite: Mathematics 104. One course. *Staff*

For Seniors and Graduates

204. Geometry for Teachers. Metric and synthetic approaches to plane and solid geometry; affine geometry, and an algebraic model of Euclidean geometry. One course. *Staff*

206. Introduction to Stochastic Processes. Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. One course. *Staff*

207, 208. Introduction to Algebraic Structures. Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants; finite dimensional inner product spaces. Prerequisites: Mathematics 104 for 207; and 207 for 208. Two courses. *Warner*

217, 218. Intermediate Analysis. Elementary point set topology and differential calculus in n-space; implicit and inverse function theorems; integration theory; differentiable manifolds; differential forms; generalized Stokes' theorem. Prerequisite: Mathematics 104 for 217; and 217 for 218. Two courses. *Staff*

221, 222, 223. Numerical Analysis. For a description of these courses, see Computer Science 221, 222, 223. Three courses. *Patrick*

227, 228. Theory of Numbers. Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisites: Mathematics 104 for 227; and 227 for 228. Two courses. *Carlitz*

229, 230. Algebraic Numbers. Ideals, unique factorization, divisors of the discriminant, determination of the class number. Prerequisites: Mathematics 207 for 229; and 229 for 230. Two courses. *Carlitz*

231. Applications of Graph Theory. Linear graphs, matrix representations, cycle structure, isomorphism, connectivity, independence, planarity, coloring, directed graphs, flows in networks as applied to engineering, management, computer science, urban systems, chemistry, physics, economics, sociology, psychology. Prerequisite: Mathematics 104 or equivalent. One course. *D. Smith*

234. Sample Designs. Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multistage sampling; methods of estimation; questionnaire construction; refusal and not-at-homes. Prerequisite: Mathematics 183. One course. *Staff*

235, 236. Algebra. Elementary categorical algebra; groups with operators, G-sets, structure groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisites: Mathematics 208 or equivalent for 235; and 235 for 236. Two courses. *Staff*

244. Analysis of Variance. Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe, Tukey, etc.), factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. One course. *Staff*

245, 246. Combinatorial Analysis. Generating functions, distributions, partitions, compositions, trees, and networks. Prerequisite: calculus. Two courses. *Carlitz*

247, 248. Arithmetic of Polynomials. Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisites: Mathematics 207 or consent of the instructor for 247; and 247 for 248. Two courses. *Carlitz*

256. Orientation for Applied Mathematics. Simulation and related notions; relation of science and technology with evolution of mathematics;

modern generalizations of the concepts of language, validity, empirical science, and statistical inference. Areas of application for various specific mathematical topics. Prerequisite: Mathematics 104. One course. *Murray*

260. Design of Experiments. Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. One course. *Burdick*

262. Non-Parametric Statistics. A study of statistical tests in which no assumption about the underlying distribution is made; single and multiple sample tests for nomial and ordinal scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 136 or consent of the instructor. One course. *Staff*

265, 266. Homological Algebra and its Applications. Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: Mathematics 236 and 271 or consent of instructor. Two courses. *Weisfeld*

269, 270. Recursive Function Theory. Basic properties, enumeration theorems, hierarchies, recursive functions of higher types, generalized recursion theory; applications. Prerequisite: Mathematics 187 or consent of the instructor. Two courses. *Shoenfield*

271, 272. Introductory Topology. Basic topological properties, including compactness, connectedness, and metrizability; product spaces and function spaces; introduction to algebraic topology. Prerequisites: Mathematics 104 for 271; and 271 for 272. Two courses. *Staff*

273, 274. Algebraic Topology. Homology and cohomology theories; complexes; introduction to homotopy groups. Cech homology theory. Prerequisite: Mathematics 272. Two courses. *Kraines*

275, 276. Probability. Foundations of probability; random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisites: Mathematics 135; or calculus and consent of the instructor. Two courses. *Staff*

284. Least Squares Analysis of Linear Models. General linear models; geometrical interpretations; multiple regression; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models; analysis of covariance; introduction to nonlinear models. Prerequisite: Mathematics 136. One course. *Burdick*

285. Applied Mathematical Methods I. Heat equation, wave equation, separation of variables, Fourier series, introduction to Hilbert space, Fourier transform, potential theory; complex variables, residues. Prerequisite: Mathematics 104. One course. *Reed*

286. Applied Mathematical Methods II. Eigenvalue problems, integral equations, Fredholm alternative, bounded linear transformations on Hilbert space, applications to partial differential equations, techniques for approximating eigenvalues. Prerequisite: Mathematics 104. One course. *Reed*

287, 288. Foundations of Mathematics. Propositional calculus, predicate calculus, axiomatized number theory. Godel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set

theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103, or consent of the instructor. Two courses. *Staff*

290. Stochastic Processes. Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. One course. *Staff*

291, 292. Analysis I, II. Measure and integration theory; introduction to functional analysis; theory of analytic functions. Prerequisite: Mathematics 218 or 140, or consent of the instructor. Two courses. *Staff*

293. Multivariate Statistics. Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's T^2 statistic and the Roy union-intersection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284 or consent of the instructor. One course. *O'Fallon*

295. Mathematical Foundations of Statistical Inference. Inference-theoretic approach to hypothesis testing, decision making, and estimation; Neyman-Pearson fundamental lemma; uniformly most powerful tests; Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275 or consent of the instructor. One course. *Staff*

297, 298. Axiomatic Set Theory. Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and their consequences. Prerequisite: consent of the instructor. Two courses. *Shoenfield*

DEPARTMENTAL MAJOR

Prerequisites. Mathematics 31, 32.

Major Requirements. Mathematics 103, 104 (or Mathematics 101, 102), and 6 additional courses in mathematics numbered above 100 which must include one of the following year sequences: Mathematics 139, 140; Mathematics 207, 208; or Mathematics 217, 218. Mathematics 183 and 244 may not be counted among the 6 courses, and at most 2 of the following 4 courses may be counted: 152, 221, 222, 223.

It is recommended that majors take a one year sequence in a natural science other than mathematics. For a student considering graduate study in mathematics, a reading knowledge of two foreign languages (often French, German, or Russian) is most desirable.

Medicine, School of—Basic Science Courses Open to Undergraduates

A student in arts and sciences may select courses from the following offered by graduate departments associated with the School of Medicine, provided he has adequate preparation. See the *Bulletin of the Graduate School* for descriptions. If no prerequisites are listed, permission of the instructor is required. A major is not offered to undergraduates in any of the departments listed below.

For permission to register for courses listed below, and for further information, see Assistant Professor Cartmill, consultant for anatomy; Assistant Professor Richardson, consultant for biochemistry; Assistant Professor Vanaman, consultant for microbiology and immunology; and Associate Professor Padilla, consultant for physiology and pharmacology.

ANATOMY

151. Anatomy of the Lower Extremities as it Relates to Locomotion. Dissection of the human adult lower extremity. Demonstration and discussion of gait, biomechanics, and kinesiology. One course. *Bassett*

193, 194. Independent Study. Open to qualified juniors and seniors with written permission of the instructor. Two courses. *Staff*

215. Contractile Processes. Prerequisite: permission of instructor. (Also listed as Physiology 216.) One course. *Reedy, Anderson, Jobsis, and Johnson*

231. Human Evolution. Prerequisite: Anthropology 93 or equivalent. (Listed also as Anthropology 231.) One course. *Cartmill*

240. Mechanisms of Biological Motility. Prerequisite: written permission of the instructor. One course. *Adelman*

264. Mammalian Embryology and Developmental Anatomy. Prerequisites: one year of zoology and consent of instructor. One course. *Duke*

BIOCHEMISTRY

209-210. Independent Study. A tutorial, based upon a laboratory or library project in biochemistry. One or two courses by arrangement. *Staff*

216. Molecular Genetics. Prerequisites: introductory courses in biochemistry and genetics. One course. *Guild and Staff*

220. Adaptations of Organisms to the Marine Environment. One course. (Given at Beaufort.) *C. Bonaventura and J. Bonaventura*

248. Introductory Biochemistry. Prerequisites: Chemistry 151, one year of college physics (second semester may be concurrent), Mathematics 32, or permission of instructors. (Listed also as Botany 248 and Zoology 248.) One course. *Staff*

276. Comparative and Evolutionary Biochemistry. Two courses. (Given at Beaufort.) *Sullivan*

293. Macromolecules. Prerequisite: physical chemistry equivalent to Chemistry 161-162. One course. *Hill, Kim, Richardson, and Tanford*

295. Enzyme Mechanisms. One course. *Fridovich and Rajagopalan*

297. Intermediary Metabolism. One course. *Kirshner and Siegel*

MICROBIOLOGY AND IMMUNOLOGY

209-210. Independent Study. A laboratory or library project. One or two courses by arrangement. *Staff*

221. Medical Microbiology. Prerequisite: consent of instructor. One course. *Joklik and Staff*

221L. Medical Microbiology. Prerequisite: consent of the instructor. One and one-half courses. *Joklik and Staff*

233. Microbiology. (Listed also as Botany 233.) One course. *Willett, Burns, Joklik, and Amos*

252. General Animal Virology and Viral Oncology. Prerequisite: consent of the instructor. One course. *Joklik, Nichols, Smith, and Zweerink*

282. Molecular Microbiology. Prerequisite: Microbiology 233 or consent of the instructor. One course. *Burns, Nichols, Vanaman, Wheat, and Willett*

291. Basic Immunology. One course. *Scott and Staff*

PHYSIOLOGY AND PHARMACOLOGY

208. Respiratory System in Health and Disease. Half-course. *Kylstra, Saltzman, and Salzano*

212. Marine Membrane Physiology. (Given at Beaufort.) Two courses. *Gutknecht, Schoffeniels, Wachtel, and Staff*

215. Topics in Developmental Physiology. Half-course. *Lieberman, Mendell, and Padilla*

216. Contractile Processes. One course. *Anderson, Jöbsis, and Johnson*

217. Membrane Transport. Half-course. *Gunn, Gutknecht, Kirk, Lauf, McManus, and Tosteson*

230. Molecular and Cellular Basis of Development. One course. *Padilla, Counce, McCarty, and Staff*

230S. Seminar. Optional seminar offered in conjunction with Physiology 230. Half-course. *Padilla, Counce, McCarty, and Staff*

252. Cellular and Chemical Pharmacology. One course. *Ottolenghi and Staff*

254. Mammalian Toxicology. One course. *Menzel and Staff*

256. Human Nutrition. Half-course. *Menzel*

Medieval and Renaissance Studies Program

Professor Mahoney, *Chairman of the Committee on Medieval and Renaissance Studies*

The Program in Medieval and Renaissance Studies, an interdisciplinary major, is designed to provide the student with a well-rounded understanding of the historical, cultural, and social forces that shaped the Medieval and Renaissance periods. The program is divided into four areas of study: fine arts (Art and Music); history; language and literature (French, German, Greek, Italian, Latin, and Spanish); and philosophy-religion.

A major consists of at least 8 courses drawn from the non-introductory courses of the four areas of study, including 3 courses in each of two areas. Besides the courses specifically listed (under departmental headings) in the Medieval and Renaissance periods, provision may be made for independent study in any of the four areas. Each student's program is tailored to his interests and needs under the supervision of a committee consisting of faculty members from appropriate departments.

After discussion with the Chairman of the Committee for Medieval and Renaissance Studies, the student submits a provisional program of study outlining special intedisciplinary interests. Normally the student should plan his program well before the end of the sophomore year since he needs to acquire a working knowledge of languages pertinent to his interests.

The courses listed below are among those now available for the fulfillment of the major prerequisites and requirements. For descriptions of the courses consult listings under the specified department.

DEPARTMENT OF ART

133. Medieval Architecture. *Sunderland*
134. Medieval Painting and Sculpture. *Sunderland*
135, 136. Art of Northern Europe in the Fifteenth and Sixteenth Centuries. *Mueller*
137, 138. Italian Renaissance Art. *Jenkins*
144. Renaissance and Baroque Architecture. *Sunderland*
233. Early Medieval Architecture. *Sunderland*
237. French Renaissance Art. *Jenkins*
245, 246. Problems in Italian Renaissance Painting. *Staff*
248. Florentine Painting During the Renaissance. *Covi*
253S. Studies in Italian Renaissance Sculpture. *Covi*
255S, 256S. Iconological Problems. *Langedijk*

DEPARTMENT OF CLASSICAL STUDIES

Latin

87, 88. Sight Reading in Classical, Medieval, and Renaissance Latin. *Staff*
221. Medieval Latin I. *Newton*
222. Medieval Latin II. *Newton*
225. Palaeography. *Newton*

Classical Studies

117. Ancient Mythographers. *Newton*

DEPARTMENT OF ENGLISH

112. English Literature of the Middle Ages. *Reiss*
115. Chaucer. *Adams, DeNeef, Nygard, or Reiss*
121. English Literature of the Sixteenth Century. *DeNeef*
123, 124. Shakespeare. *DeNeef, Jones, or Williams*
125. English Literature of the Early Seventeenth Century. *DeNeef*
127. Milton. *Lievsay or Price*
129. English Drama from the Middle Ages through the Eighteenth Century. *Clum or Reardon*
207, 208. History of the English Language. *Nygard or Reiss*
210. Old English Literary Tradition. *Nygard or Reiss*
212. Middle English Literary Tradition. *Nygard or Reiss*
215. Chaucer. *Nygard or Reiss*
216. Chaucer. *Nygard or Reiss*
221. English Prose of the Sixteenth Century. *Lievsay*
222. English Nondramatic Poetry of the Sixteenth Century. *DeNeef or Lievsay*
223. Spenser. *DeNeef or Lievsay*
224. Shakespeare. *Williams*
225, 226. Tudor and Stuart Drama, 1500-1642. *Randall*
229. English Literature in the Seventeenth Century. *Lievsay, Randall, or Williams*
232. Milton. *Lievsay*

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

205, 206. Middle High German. *Staff*
215S. Seventeenth Century Literature. *Borchardt*

216. History of the German Language. *Staff*
217S. Renaissance and Reformation Literature. *Borchardt*

DEPARTMENT OF HISTORY

103. The Economic, Social, and Political Institutions of Europe, 1250-1600. *Witt*
104. The Intellectual Life of Europe, 1250-1600. *Witt*
107. Social and Cultural History of England. *Ferguson*
133. Medieval Europe, 300-1000 A.D. *Young*
134. Medieval Europe, 1000-1400 A.D. *Young*
154. Medieval England. *Young*
173. History of Spain and the Spanish Empire from Late Medieval Times. *TePaske*
195A-196A. Renaissance Intellectual History. *Witt*
195N-196N. The English Renaissance. *Ferguson*
221. Problems in the Economic and Social History of Europe, 1200-1700. *Witt*
222. Problems in European Intellectual History, 1250-1550. *Witt*
237S. Europe in the Early Middle Ages. *Young*
238S. Europe in the High Middle Ages. *Young*
267S, 268S. From Medieval to Early Modern England. *Ferguson*

DEPARTMENT OF MUSIC

159S. Music History IV: History of Music to 1600. *Kirkendale and Tirro*
166S. The Renaissance Madrigal. *Saville*

DEPARTMENT OF PHILOSOPHY

119. Medieval Philosophy. *Mahoney*
120. Late Medieval and Renaissance Philosophy. *Mahoney*
218. Medieval Philosophy. *Mahoney*

DEPARTMENT OF RELIGION

121. Christianity in Europe from the Middle Ages to the Protestant Reformation. *Staff*
135. Jewish Religious Thought. *Bland*

DEPARTMENT OF ROMANCE LANGUAGES

French

106S. Montaigne. *Tetel*
114. The Sixteenth Century. *Vincent or Tetel*
117S. Masterpieces of French Medieval Literature. *Ripley*
119. French Drama of the Seventeenth Century. *Staff*
213. French Literature of the Seventeenth Century. *Staff*
219. Old French Literature. *Vincent*
225. French Prose of the Sixteenth Century. *Tetel*
226. French Poetry of the Sixteenth Century. *Tetel*

Italian

141, 142. Masterworks of Italian Literature in English Translation. *Caserta*

183. Readings in Italian Literature. *Caserta*
284. Dante. *Fowlie*
288. The Renaissance. *Tetel*

Spanish

117S. Masterpieces of Spanish Medieval Literature. *Garci-Gómez*
161. Spanish Literature of the Renaissance and the Baroque. *Miller or Wardropper*
167. Cervantes: *Don Quijote*. *Predmore*
170. The Picaresque Novel. *Garci-Gómez*
251. The Origins of Spanish Prose Fiction. *Wardropper*
252S. Spanish Lyric Poetry before 1700. *Wardropper*
253. The Origins of the Spanish Theater. *Wardropper*
257. Old Spanish. *Davis*
258. Medieval Literature. *Davis or Garci-Gómez*
265. Cervantes. *Predmore or Wardropper*
266. Drama of the Golden Age. *Wardropper*

Romance Languages

124. Continental Humanism. *Tetel*

Music

Associate Professor Tirro, *Chairman;* Professor Hanks, *Director of Undergraduate Studies;* Associate Professor Bryan, *Supervisor of Freshman Instruction;* Professors Bone, Douglass, Hamilton, Mueller, and Withers; Associate Professors Kirkendale and Saville; Resident Artist Ciompi; Assistant Professors Friedberg, Henry, and Maves; Lecturers Fishbaugh and J. Smith; Visiting Lecturer Coker; Part-time Instructor Redding; Staff Associates Erdberg, Evans, Gudger, Gulick, Kort, Phelps, Raimi, Shaw, D. Smith; Artist Associates Amick, B. Fecteau, R. Fecteau, Gilmore, Henes, Neilson, Pederson, and Weddle; Librarian Hammond

THEORY AND COMPOSITION

7-8. Dictation and Sight-Singing. Techniques of aural analysis and development of sight-reading skills. Music majors should take this course concurrently with Music 65-66. Skill course. Half-course each semester. *Redding*

65. Fundamentals of Music Theory. Physical properties of sound; principles of diatonic tonal organization; melodic and harmonic constructions; elementary counterpoint and figured base. Skill course. Prerequisite: basic knowledge of musical notation and vocabulary. Music majors should take Music 7 concurrently. One course. *Maves*

66. Tonal Harmony. Harmonic language of eighteenth and nineteenth century classicism; functional chromaticism, sectional forms. Music majors should take Music 8 concurrently. Prerequisites: Music 65 and 7. One course. *Maves*

107-108. Keyboard Theory. Harmonic principles of tonal music applied to the keyboard; score reading, figured bass, melodic harmonization, modulation, transposition. Music majors should take this concurrently with Music 115-116. Skill course. Prerequisites: Music 65-66, 7-8, and keyboard proficiency. Half-course each semester. *Gudger*

115S. Modal Counterpoint. Polyphonic, contrapuntal, and melodic practices found in the sacred and secular works of the sixteenth and seventeenth centuries. Music majors should take Music 107 concurrently. Prerequisite: Music 65-66. One course. *Tirro*

116S. Linear Tonal Practice. Organic tonal elements (including canon, invention, chorale prelude, fugue) as found in the works of Bach, Mozart, Haydn, Beethoven, and Brahms. Prerequisite: Music 115S. One course. *Tirro*

119, 120. Experimental Music. The development of skills necessary to compose music, utilizing either computer synthesized sound or the components available in the electronic music studio. Composition for conventional and nonconventional instruments. Prerequisite: Music 123S, 124S. Two courses. *Maves*

122. Orchestration. Characteristics and transpositions of the instruments of the symphony orchestra and concert band. Instrumentation from pre-existing piano scores, or the student's original compositions, for string, woodwind, brass and percussion ensembles, orchestra or band. Prerequisite: Music 116. One course. *Bryan*

123S, 124S. Composition I. Composing original music in the smaller forms for voice, piano, and other instruments. Studies in contemporary compositional techniques. Prerequisite: Music 65, 66 or permission of the instructor. Two courses. *Hamilton and Maves*

141S, 142S. Music Theory III: Composition and Analysis. The development of technical and expressive means in various media and styles. The completion of an original work in an instrumental or choral medium. Prerequisites: Music 116, 139, 158, or permission of the instructor. Two courses. *Hamilton*

HISTORY AND LITERATURE

51, 52. Introduction to Music Literature. The literature of music of Western civilization; acquisition of critical insights into musical styles, forms, and techniques. Representative works of major composers in all media, instrumental and vocal. Two courses. *Henry*

125. Masterworks of Music. Historical, biographical, and analytical study of works by major composers of the seventeenth through the twentieth centuries. One course. *Bone, Friedberg, Mueller, or Saville*

139. Twentieth Century Music. Influential creative stylistic developments in music of the present century. A critical survey of works by Bartok, Berg, Schönberg, Stravinsky, and Webern as a means of establishing a relative standard of values for subsequent independent exploration. Prerequisite: a one-year course in music theory or literature, or permission of the instructor. One course. *Friedberg and Hamilton*

156S. Music History I: History of Music from 1600 to 1750. Prerequisites: Music 7-8, 65, or permission of instructor. One course. *Saville and Kirkendale*

157S. Music History II: History of Music from 1750 to 1830. Prerequisites: Music 7-8, 65, or permission of the instructor. One course. *Bryan*

158S. Music History III: History of Music from 1830 to 1910. Prerequisites: Music 7-8, 65, or permission of the instructor. One course. *Hamilton and Friedberg*

159S. Music History IV: History of Music to 1600. Prerequisite: Music 7-8, 65, and two courses in music history, or permission of the instructor. One course. *Kirkendale and Tirro*

163. Music in the Eighteenth Century. Baroque, rococo, and classical styles and concepts represented in different instrumental and vocal genres; the composers and their historical and artistic environment. Prerequisite: one course in music theory or literature, or permission of the instructor. One course. *Bryan*

164. Music in the Nineteenth Century. Romantic and post-romantic music; its relation to the artistic and literary movements of the century. Prerequisite: one course in music theory or literature, or permission of the instructor. One course. *Mueller*

165. Opera Literature. From the Florentine Camerata to the present. The operatic idea, with attention to changing relationships of music and text; opera as social commentary; formal and stylistic means. Selected composers from Monteverdi to Berg. One course. *Saville*

166S. The Renaissance Madrigal. History of Italian and English madrigal forms from the fourteenth century Ars Nova through the Renaissance into the early Baroque of the 1620's. Ability to read music and some experience with Italian helpful but not required. One course. *Saville*

171, 172. The Organ and its Literature. The relation of organ literature and organ building from the sixteenth century to the present. Two courses. *Douglass*

174. Introduction to Jazz. A multidisciplinary survey for non-majors which examines musical, aesthetic, sociological, and historical aspects of jazz. One course. *Coker and Tirro*

INDEPENDENT STUDY AND SEMINARS

Admission to these courses will be subject to the approval of the Director of Undergraduate Studies in the Department of Music and the individual instructor. The instructor as well as the course content will be established in accordance with the individual student's interests and capacities.

The department offers work leading to Graduation with Distinction. See the section on Academic Honors.

179, 180. Independent Study in Musical Performance.* Open only to sophomores possessing an exceptional technical and interpretive command of a musical medium. Prerequisites: previous registration in private instruction in applied music at Duke, audition, and permission of instructor. Two courses. *Staff*

181, 182. Independent Study in Musical Performance.* Same as 179, 180, but for juniors. Two courses. *Staff*

183, 184. Independent Study in Musical Performance.* Same as 179, 180, but for seniors. Two courses. *Staff*

185S, 186S. Seminar in Music. Guidance in the sources and materials of music and in the methods of stylistic analysis and criticism. A background of

*The schedule of fees for private lessons as published on page 176 is applicable to courses 179, 180, 181, 182, 183, 184.

historical, stylistic, and theoretical knowledge is essential. Formal papers required. Two courses. *Staff*

191, 192. Independent Study. Directed reading, research, and musical analysis within a prescribed area of musical literature. Open only to highly qualified students in the junior year, by permission of the department. One or two courses. *Staff*

193, 194. Independent Study. Same as 191, 192, but for seniors. One or two courses. *Staff*

195S, 196S. Seminar in Music. Same as 185S, 186S but for seniors, not necessarily restricted to candidates for degree with distinction. Two courses. *Staff*

MUSIC EDUCATION AND PEDAGOGY

57S, 58S, 59S, 60S. Vocal Diction. Problems of diction for the singer. Study of standard pronunciation with special emphasis on phonetics in English, Italian, German, and French. Four half-courses. *Hanks and Redding*

121. Conducting. The conducting of orchestral and vocal scores. Score-reading and analysis, principles of interpretation, establishment of vocal and instrumental conductoral techniques leading to practical experience in conducting the department musical organizations in rehearsal. Prerequisite: Music 115, 116, or permission of the instructor. One course. *Bone*

151. Public School Music Education (Elementary). Basic musical skills; music theory and reading; song literature; rhythmic activities; listening; instruction on tonettes, recorders, autoharp, bells, selected percussion instruments, and piano chording. Half-course. *Redding*

152. Public School Music Education II (Elementary). Continuation of Music 151 with emphasis on music appreciation as it pertains to social studies in public schools. Study and analysis of key words in music literature. Prerequisite: Music 151 or permission of the instructor. Half-course. *Redding*

APPLIED MUSIC

The study of applied music concerns the understanding of music literature through performance. Private instruction is offered in instruments and voice. Class instruction is offered in small and large ensemble experience. Students must arrange an audition with the instructor prior to registration, either in person or by tape recording. All courses may be repeated for credit. Not more than two quarter-credit courses in the ensemble group (courses 100 and above) may be taken concurrently.

Private instruction: ½ hour, ¼ course credit

80. Piano. *Withers, Fishbaugh, Evans, Phelps, Kort, and D. Smith*
81. Strings. *Ciompi, Mueller, Erdberg, and Raimi*
82. Woodwinds. *Henry, B. Fecteau, and Weddle*
83. Brass. *Bryan, R. Fecteau, Amick, and Henes*
84. Percussion. *Maves*
85. Voice. *Hanks, Redding, and Shaw*
86. Organ. *Douglass and Gulick*

Private instruction: 1 hour, ½ course credit

90. Piano. *Evans, Withers, Phelps, D. Smith, Fishbaugh, and Kort*
91. Strings. *Ciompi, Mueller, Erdberg, and Raimi*

92. Woodwinds. *Henry, B. Fecteau, and Weddle*
93. Brass. *Bryan, R. Fecteau, Amick, and Henes*
94. Percussion. *Maves*
95. Voice. *Hanks, Redding, and Shaw*
96. Organ. *Douglass and Gulick*

Ensemble classes: ¼ course credit

100. Symphony Orchestra. *Bone*
101. Wind Symphony. *Bryan*
102. Marching Band. *Henry*
103. Jazz Ensemble. *Coker*
104. String Ensemble. *Staff*
105. Wind Ensemble. *Staff*
106. Piano Ensemble. *Staff*
109. Chancel Singers. *J. Smith*
110. Collegium Musicum. *Tirro*
111. Opera Workshop. *Hanks and Friedberg*
112. Chapel Choir. *J. Smith*
113. Chorale. *J. Smith*

Credit in Applied Music. (Skill courses—credit not applicable to distributional requirements.*) Credit for instruction in courses below 100 is granted on the basis of a half-course per semester for one hour of private instruction per week and a minimum of six hours practice weekly; or a half-course per year for one-half hour of private instruction, or one period of class study, and a minimum of six hours practice per week. An additional weekly class meeting for performance and criticism may be required by the instructor without additional credit. Credit for instruction in courses above 100 is granted on the basis of a half-course per year for one rehearsal period of instruction and a minimum of three hours practice per week.

Fees. Students are charged for all applied music media below 100. Fees are payable to the Bursar's Office at Duke University upon notification from that office at the beginning of each semester as follows:

One ½ hour private lesson per week for one semester $60.00
Two ½ hour private lessons per week or one 1-hour private lesson per week for one semester 120.00
One 1-hour class lesson per week for one semester 35.00

No charge is made for practice room facilities.

DEPARTMENTAL MAJOR

Prerequisites. Music 7-8, 65, 66, 107-108, and one year of applied music study in instrument or voice. Any or all of these may be exempted through demonstration of proficiency by examination and/or audition.

Major Requirements. Music 115, 116, 156, 157, 158, 159, and one additional elective course in the department.

Naval Science

For courses in Naval Science, see Reserve Officers Training Program.

Philosophy

Professor Welsh, *Chairman;* Assistant Professor Ross, *Director of Undergraduate*

*Subject to instructor's approval, a student at an advanced level in applied music may take courses for tutorial and distributional requirements. These courses shall be designated by adding a *T* to the appropriate course number. Beginning students and others who have not reached an advanced level will continue to take the regular applied music courses.

Studies; Professors Negley and Peach; Associate Professors Mahoney, Roberts, and Sanford; Assistant Professor Benditt; Visiting Associate Professor Rachels; Visiting Assistant Professor Bamford; Visiting Lecturer Boudreaux

The undergraduate program in the Department of Philosophy is designed to acquaint students with the content and the structure of philosophical theory in various areas. Discussion is encouraged so that the student can engage actively in the philosophical examination of problems.

Course offerings fall into two general categories: the systematic and the historical. In a systematic treatment, the organization of a course is primarily in terms of the problems presented by the subject matter of that course, as in logic, ethics, and metaphysics. In historical courses, attention is directed more to the order of development in the thought of a particular philosopher (Plato, Aristotle, Kant), or in a historical period. In all courses, reading of the works of philosophers will acquaint the students with the important and influential contributions to the definition and solution of philosophical issues.

The problems raised in philosophy in respect to the various fields of the arts and sciences involve questions which are not normally given attention in those particular disciplines. In the consideration of such problems, therefore, it is expected that the student will acquire some understanding and perspective of the major areas of man's intellectual endeavor. In this sense, philosophical comprehension is an essential part of a student's learning and education.

Only one of 41, 42, 43S, or 44S may be taken for credit. Not open to juniors and seniors.

41. Introduction to Philosophy. Examination of problems in philosophy; emphasis on metaphysics and theory of knowledge. One course. *Staff*

42. Introduction to Philosophy. Examination of problems in philosophy; emphasis on ethics and value theory. One course. *Staff.*

43S. Introduction to Philosophy. Philosophy 41 conducted as a seminar. One course. *Staff*

44S. Introduction to Philosophy. Philosophy 42 conducted as a seminar. One course. *Staff*

48. Logic. A study of the conditions of effective thinking and clear communication. Examination of the basic principles of deductive reasoning. One course. *Ross* or *Sanford*

93. History of Ancient Philosophy. The pre-Socratics, Socrates, Plato, Aristotle, and post-Aristotelian systems. Freshman prerequisites: previous philosophy course and permission of the instructor. One course. *Mahoney*

94. History of Modern Philosophy. Bacon, Hobbes, Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and Kant. Freshman prerequisites: previous philosophy course and permission of the instructor. One course. *Peach* or *Roberts*

101. Philosophy of Religion. Selected concepts and doctrines. One course. *Roberts*

102. Aesthetics: The Philosophy of Art. The concept of beauty, the work of art, the function of art, art and society, the analysis of a work of art, criticism in the arts. One course. *Welsh*

103. Symbolic Logic. Detailed analysis of deduction and of deductive systems. Open to sophomores by permission of the instructor. One course. *Ross*

104. Philosophy of Science. The principal philosophical and methodological problems in contemporary science. One course. *Ross*

105. Philosophy of History. History as a form of enquiry; problems of explanation; objectivity and the historical individual; general interpretations of the historical process. One course. *Staff*

106. Philosophy of Law. Natural law theory; legal positivism; legal realism; the relation of law and morality. One course. *Benditt*

107. Political and Social Philosophy. Discussion of the fundamental principles of political and social organizations, with particular attention to democratic philosophy, corporate theory, and Marxist-Soviet philosophy. One course. *Negley*

108. Social Ideals and Utopias. Reading of selected Utopias; analysis of the value structures and political principles of these ideal societies. One course. *Negley*

109. Philosophy of Language. A philosophical analysis of problems arising in the study of language and symbolism. Topics include: theories of language, the nature of signs and symbols, theories of meaning, types of discourse (scientific, mathematical, poetic), definition, ambiguity, metaphor. One course. *Welsh*

110. Epistemology. A treatment of the problems of truth and knowledge; of *a priori* and empirical statements; and of theories of perception and probability. One course. *Sanford*

111. Metaphysics. A selection from the following: theories of substance, universals, identity, space, time, and causality; determinism and action; the relation of mind and body. Prerequisite: one course in philosophy. One course. *Sanford*

112. Philosophy of Mind. Such topics as mind and body, thought, perception, persons, and personal identity. One course. *Aquila*

116. Sysfematic Ethics. Problems in moral philosophy: the nature of morality, ethical relativism, egoism, utilitarianism. Both historical and contemporary readings, with emphasis on the latter. One course. *Benditt*

117. Ancient and Modern Ethical Theories. The development of ethical thought in the West; the interaction between culture and ethical theory, with special reference to the Greek city-state, Roman law, the Renaissance, the Reformation, and the rise of modern science. Readings in the great ethical philosophers. One course. *Welsh*

119. Medieval Philosophy. Readings and discussion of Christian, Islamic, and Jewish philosophy from late antiquity to 1300. Special emphasis on the nature and destiny of man, human knowledge and conduct, and the question of the existence and nature of God. One course. *Mahoney*

120. Late Medieval and Renaissance Philosophy. Critical trends in fourteenth century philosophy; Renaissance Platonism, humanism and theories of love; Aristotelianism and the immortality controversy; the rebirth of scepticism; and the rise of modern philosophy. One course. *Mahoney*

132. Nineteenth Century Philosophy. Major nineteenth century philosophers; emphasis on the German tradition: Hegel, Schopenhauer, and Nietzsche. One course. *Staff*

134. Existentialism. One or more major texts, such as Sartre's *Being and Nothingness*. One course. *Staff*

191, 192, 193, 194. Independent Study. Directed reading and research. Open only to highly qualified students in the junior and senior years, by permission of the department. *Staff*

196S, 197S, 198S, 199S. Seminars in Philosophy. Prerequisite: one course in philosophy or permission of the instructor. One course each. *Staff*

For Seniors and Graduates

202. Aesthetics: The Philosophy of Art. A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music and painting. Problems discussed include the role of standards in criticism, aesthetic judgment, interpretation, and evaluation in the arts, meaning in the arts, art and truth, the arts and morality. Open to juniors with the approval of the instructor. One course. *Welsh*

203. Contemporary Ethical Theories. Study of the nature and justification of basic ethical concepts in the light of the chief ethical theories of twentieth century British and American philosophers. One course. *Benditt*

204. Philosophy of Law. Natural law theory and positivism; the idea of obligation (legal, political, social, moral); and the relation of law and morality. One course. *Benditt*

205. Philosophy of History. The nature of historical knowledge and inquiry; theories of the historical process. One course. *Staff*

206. Topics in Ethical Theory. One course. *Benditt*

208. Political Values. Analysis of the systematic justification of political principles and the political values in the administration of law. One course. *Negley*

211. Plato. A critical study of selected dialogues, with emphasis on problems in epistemology and metaphysics. One course. *Mahoney*

217. Aristotle. A study of passages from the *Organon*, *Physics*, *De Anima*, and *Metaphysics*. One course. *Mahoney*

218. Medieval Philosophy. Selected problems in medieval philosophy. One course. *Mahoney*

225. British Empiricism. A critical study of the writings of Locke, Berkeley, or Hume with special emphasis on problems in the theory of knowledge. One course. *Peach*

227. Continental Rationalism. A critical study of the writings of Descartes, Spinoza, or Leibniz with special emphasis on problems in the theory of knowledge and metaphysics. One course. *Peach*

228. Recent and Contemporary Philosophy. A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore, Russell, Wittgenstein, Wisdom, and Ryle. One course. *Welsh*

231. Kant's Critique of Pure Reason. One course. *Staff*

232. Recent Continental Philosophy. Selected topics. One course. *Staff*

233. Methodology of the Empirical Sciences. Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and ob-

servation, probability and induction, and other topics. Prerequisite: permission of the instructor. One course. *Ross*

234. Problems in the Philosophy of Science. Selected problems in the physical and nonphysical sciences such as space and time, measurement and determinism. Prerequisite: permission of the instructor. One course. *Ross*

241. Symbolic Logic. Detailed analysis of deduction and of deductive systems. One course. *Staff*

251. Epistemology. Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism, and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. One course. *Sanford*

252. Metaphysics. Selected topics: substance, qualities and universals, identity, space, time, causation, and determinism. One course. *Sanford*

253. Philosophy of Mind. Analysis of concepts such as thought and belief; issues such as mind-body relations, thought and action, the nature of persons and personal identity. One course. *Staff*

254. Philosophy of Religion. Topics such as proofs of the existence of God, meaningfulness of religious language, the problem of evil, immortality and resurrection. One course. *Roberts*

255. Philosophy of Action. Problems in the individuation, characterization, and explanation of human actions; an analysis of such concepts as choosing, deciding, intending, doing, making, letting. One course. *Staff*

260. Wittgenstein. An examination of the *Tractatus* or the *Investigations*. One course. *Welsh*

291, 292. Seminars in Special Topics. One course each. *Staff*

DEPARTMENTAL MAJOR

Major Requirements. Eight semester courses in philosophy of which at least 6 must be in courses numbered above 48. The following must be included: Philosophy 93 and 94; one non-introductory course in theory of value. Philosophy 48 is recommended, though not required.

Related Work. Two courses minimum in each of two departments approved by the philosophy adviser. Courses may not be those primarily open to freshmen. There is no restriction in principle as to departments in which related work may be taken, and the approval of the philosophy adviser is required only to ensure some coherence in the program of major and related work as a whole.

The department offers work leading to graduation with distinction. See the section on Honors.

Physics

Professor Newson, *Chairman;* Professor Roberson, *Director of Undergraduate Studies;* Professor Bilpuch, *Supervisor of Freshman Instruction;* Professors Biedenharn, Fairbank, Gordy, Greuling, Lewis, Meyer, Robinson, Walker, and Walter; Associate Professors De Lucia, Golner, Goshaw, Lawson, Lisowski, and Loos; Instructors Outlaw and Rickel; Lecturer Maripuu

Physics courses aim to develop in students a knowledge of the fundamental concepts of physics and the analytical skills necessary for scientific work. The undergraduate program provides students with appropriate academic back-

ground for positions in industry, government laboratories, or for graduate study. A program is also available which prepares the student for the study of medicine while giving him a strong background in physics.

32. History of Modern Physics. From 1900 to the present. Theories including atomic structure, quantum theory, relativity, nuclear and particle physics; their developers and technological applications. No previous knowledge of physics assumed. One course. *Walker*

41, 42. Fundamentals of Physics. For students interested in majoring in physics; taken in the freshman year. Basic principles of physics, mainly classical, at a level similar to Physics 51-52, but with emphasis on laying a foundation for further study. Three lecture-recitations and one three-hour laboratory. Prerequisites: approval of the department and Mathematics 31-32 or equivalent (may be taken concurrently). Two courses. *Lewis*

41P, 42P. Preceptorials. Elective preceptorials for students enrolled in Physics 41, 42.

51, 52. General Physics. Basic principles of general physics treated quantitatively. Designed for students entering medicine, engineering, and the sciences. Not open for credit to students who have completed Physics 41, 42. Students planning to major in physics should enroll in Physics 41, 42 in their freshman year. Prerequisites: Mathematics 31, 32 or equivalent (may be taken concurrently with permission of instructor). Two courses. *Cusson, Evans, Fairbank, Goshaw, Greuling, Lisowski, Outlaw, or Rickel*

51P, 52P. Preceptorials. Elective preceptorials for students enrolled in Physics 51, 52.

55. Introduction to Astronomy. Man's evolving theory of the physical universe. Cosmological models, galaxies, stars, interstellar matter, the solar system, and experimental techniques and results. Optional observational laboratory. One course. *De Lucia*

102. Applications of Modern Physics in Medicine. Recent applications of physical phenomena in medical investigations including lasers, ultrasonics, X-rays, radioactivity, radiation therapy, cryogenics, and electronic techniques. Prerequisites: Physics 41-42 or 51-52. One course. *Walter*

106. Topics in Astrophysics. Current topics with emphasis on contributions of the basic sciences. Experimental and observational opportunities. Prerequisite: Physics 55 or permission of the instructor. One course. *De Lucia*

161. Modern Physics. Relativity, quantum phenomena, atomic and molecular structure and spectra, solids, statistical physics, nuclear physics, elementary particles. Prerequisites: Physics 41-42 or 51-52 and Mathematics 32. One course. *Roberson*

171. Electronics. Elements of electronics including circuits, transfer functions, solid state devices, transistor circuits, operational amplifier applications, digital circuits and computer interfaces. Three lectures and one three hour laboratory. Prerequisites: Physics 41-42 or 51-52. One course. *Fortney*

176S. Thermodynamics and Kinetic Theory. Thermodynamics, kinetic theory, and elementary statistical mechanics. Prerequisites: Physics 41-42 or 51-52, and differential and integral calculus. One course. *Meyer*

181. Introductory Mechanics. Newtonian mechanics at the intermediate level, Lagrangian mechanics, linear oscillations, special relativity. Prerequisites:

Physics 41-42 or 51-52 and differential and integral calculus. One course. *Fortney*

185. Optics and Spectroscopy. Wave motion; Fourier methods; geometrical and physical optics; coherence; lasers; atomic and molecular spectra. Prerequisites: Physics 41-42 or 51-52, and differential and integral calculus. One course. *Loos*

A course in general college physics and a course in differential and integral calculus are prerequisites to all courses numbered 200 and above.

211, 212. Advanced Modern Physics. Quantum theory with applications to the study of atoms, molecules, solids, and nuclei. Prerequisites: Physics 161, 181 or equivalents. Mathematics 285-286 or equivalent (may be taken concurrently). Two courses. *Robinson*

217S, 218S. Advanced Physics Laboratory and Seminar. Experiments involving the fields of mechanics, electricity, magnetism, heat, optics, and modern physics. Two courses. *Meyer*

223. Electricity and Magnetism. Electrostatic fields and potentials, boundary value problems, magnetic induction, energy in electromagnetic fields, Maxwell's equations, introduction to electromagnetic radiation. One course. *Loos*

225, 226. Elementary Investigations. The aim of this course is to provide training in the laboratory and library methods of physical research. Properly qualified students may conduct elementary investigations under the supervision of a member of the staff. One course each semester. *Staff*

282. Mechanics of Continuous Media. Small vibrations, rigid body motion, hydrodynamics, elasticity. Prerequisites: Physics 41-42 or 51-52 and differential and integral calculus. One course. *Walker*

DEPARTMENTAL MAJOR

A student planning to major in physics should enroll in Physics 41-42 in his freshman year. He should also arrange to complete the necessary mathematics as soon as possible.

The A.B. degree

Prerequisites. Physics 41-42 or 51-52 or equivalent; Mathematics 31-32 or equivalent, 103, 104, or 131; two courses in another natural science.

Major Requirements. At least 6 semester-courses in physics from the available 100- and 200-level courses. Of these at least 1 course must be a laboratory course. A physics major also normally takes 2 courses of related work beyond the introductory level, in a program approved by his physics adviser.

The B.S. degree

Prerequisites. Physics 41-42 or 51-52 or equivalent; Mathematics 31-32 or equivalent, 103, 104, or 131; two courses in another natural science.

Major Requirements. At least 8 semester-courses in physics at the 100- and 200-level. These courses are normally Physics 161, 171, 181, 176, 211, 212, 218 and 223. Students planning graduate study are urged to take two or more electives in physics. A B.S. physics major also takes 2 courses of related work beyond the introductory level, in a program approved by his physics adviser.

The department offers to the student in his senior year the possibility of being associated with research conducted in this department. Such work may lead to graduation with distinction. See the section on Honors.

Political Science

Professor Barber, *Chairman*; Professor Hall, *Director of Undergraduate Studies*; Professors Ball, Braibanti, Cleaveland, Cole, Grzybowski, Hallowell, Holsti, Hough, Kornberg, and Leach; Associate Professors Fish, Johns, Paletz, and Price; Assistant Professors Eldridge, Hawley, McKean, Mishler, Salamon, Spragens, Trilling, and Valenzuela; Lecturers O'Barr and Stone

The objective of the Department of Political Science is to acquaint students with the theory and practice of government and politics at the local, state, national, and international levels. Although primary attention is focused upon the American political and administrative system, emphasis is also placed upon a comparative study of the political institutions and movements of thought peculiar to the nations of Europe, Latin America, Africa, and Southern Asia. The student's attention is also directed to the problems encountered in international organization, politics, and law. The development of political philosophy from Plato to the present day is an essential part of the department's course offerings. Methods of study include the empirical, the historical, the legal, the comparative, and the philosophical.

Directing its effort to an intelligent understanding of the contemporary world and of the responsibilities which are laid upon citizens of a democracy, the Department of Political Science shares the objectives of a liberal arts education. Although the department does not aim at vocational education, the knowledge it seeks to impart should be useful to anyone contemplating a career in law, government service, or politics.

Students intending to major in the department should take Political Science 61 or 61D. Ordinarily one of them must be taken before proceeding to more advanced work in the department. This rule may be waived with the consent of the Director of Undergraduate Studies.

The advanced courses are divided into four major groups. Majors are required to take at least 1 course in three of these groups.

Political Science 197 and 198 are designed to provide an opportunity for majors in the department to qualify for graduation with distinction.

INTRODUCTORY COURSES

Either of the following courses serves as an introduction to the American system of government and politics; either is ordinarily completed before proceeding to higher level courses. Political Science 61 is taught in regular class format, in which the instructor lectures and leads discussion. Political Science 61D is taught in two large lecture sessions per week, with the third session being a small discussion section of approximately 15 students.

61. The American Political System. Theory and practice of American government and politics. Federal-state relations, the separation and interrelationships of the executive, legislative, and judicial branches of government, judicial review, the role of political parties and public opinion, the formulation and execution of domestic and foreign policy, civil liberties. (Not open to students who have had Political Science 61D.) One course. *Staff*

61D. The American Political System. Introduction to American politics, emphasizing the impact of ideology and political culture and the role of parties and elections, interest groups and pluralist politics, and presidential leadership. Lectures and small discussion groups. (Not open to students who have had Political Science 61.) One course. *Price*

Students planning to major in political science or students seeking to meet the social science requirement should follow Political Science 61 or 61D with a 100-level course of their choice. Sophomores may not register in courses numbered above 200.

POLITICAL THEORY AND METHODOLOGY

123. Introduction to Political Philosophy. The nature and enduring problems of political philosophy, illustrated by selected theorists in the Western political tradition. One course. *Hallowell or Spragens*

124D. The Political Novel. Politics and political concepts (totalitarianism, utopianism, fascism, nihilism, obligation and rights) as portrayed in the novels of Silone, Koestler, Orwell, Dostoevsky, and others. One course. *Staff*

126. Democratic Theory and Political Reality. Normative goals and empirical analyses of existing democratic states. One course. *Spragens*

131. Introduction to American Political Thought. Basic elements in the American political tradition as developed from its English roots to the present. One course. *Staff*

132. Contemporary Political Ideologies. Liberalism, socialism, Marxism and its variants, fascism, contemporary democratic theory. One course. *Hallowell or Spragens*

133. Policy Choice as Value Conflict. (Also listed as Public Policy Studies 116.) One course. *Payne*

144. American Political Thought since the Gilded Age. The Progressive Period and the recurring themes of contemporary debate. Attempts to refurbish or develop alternatives to the dominant "liberal tradition." The ideological roots of black, feminist, and "conservative" protest. One course. *Price*

197S. Principles and Methods of Political Inquiry. Philosophical, scientific, and behavioralistic approaches to political problems; contemporary conceptual frameworks, including systems analysis and functionalism, group theory, and mathematical models. Prerequisite: permission of instructor. One course. *Trilling*

222. Empirical Theory. Critical examination of contemporary, non-normative conceptual frameworks for political inquiry, with emphasis on the qualifications of these frameworks as theories. One course. *Trilling*

223. Political Philosophy from Plato to Machiavelli. Intensive analysis of the political philosophies of Plato and Aristotle, a survey of medieval political thought and an analysis of the significance of Machiavelli. One course. *Hallowell*

224. Modern Political Theory. An historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. One course. *Hallowell*

229. Recent and Contemporary Political Theory. The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, nationalism, fascism and national socialism, the crisis in modern democracy, Christianity and the social order. (Not open to students who have taken Political Science 132.) One course. *Hallowell*

231. American Political Theory. An analysis of the main currents in American political thought from colonial beginnings to the present day, with emphasis upon the development of liberalism in America. One course. *Staff*

233. Research Methodology. Measurement, causal analysis, and comparison of different levels of analysis, and other problems in political research. One course. *Trilling*

236. Statistical Analysis. Introduction to statistics in political research, emphasizing inferential statistics through simple regression and correlation. One course. *Trilling*

249. Comparative Political Analysis and Political Development. General methodology of comparison of political systems. Institutional, structural, functional, and configurative modes of analysis. Theory of political development. Theoretical problems of induced political change. One course. *Braibanti*

260. The Tradition of Political Inquiry. Past and present problems, goals, presuppositions, and methods. One course. *Spragens*

COMPARATIVE GOVERNMENT AND POLITICS

101, 102. Introduction to the Civilizations of Southern Asia. (Also listed as Interdisciplinary Course 101, 102.) One course. *Staff*

117. Comparative Legal Systems. Origins, development, and mutual influences of modern legal systems: Roman and civil law; the Common Law and the Anglo-Saxon tradition; Islamic law; communist legal systems and the legal systems of Black Africa. One course. *Grzybowski*

135. Comparative Legislative Behavior. Structures, processes, functions, and behavior of legislatures and legislative-like institutions in a variety of Western and non-Western societies with emphasis on the role of legislatures in policy formation, national integration, and modernization/development. One course. *Mishler*

136. Comparative Government and Politics: Europe. The impact on social and economic change of European politics. Totalitarian vs. pluralistic models. Formal and informal political integration. Special attention to Great Britain, France, West and East Germany, the Soviet Union. One course. *Cole or Johns*

151. Comparative Government and Politics: Latin America I. Historical and cultural context of political institutions and behavior; the role of traditional and emerging groups and forces; political instability and the decision-making process. One course. *Valenzuela*

152S. Comparative Government and Politics: Latin America II. Analysis of the politics of major countries including Argentina, Brazil, Chile, Cuba, and Mexico. One course. *Valenzuela*

155. Problems of Political Development in the New States. Survey of change and modernization in Africa and Asia; nationalism and neutralism, role of political parties, the military, and the bureaucracy in nation-building; economic growth and foreign aid. One course. *Braibanti*

161S. Comparative Government and Politics: Africa. Nationalism, nation-building, and problems of development in selected states of sub-Saharan Africa. One course. *Johns*

162. Comparative Government and Politics: Communist Political Systems.

Analysis of selected communist movements in Europe, Asia, and the Third World with emphasis upon party structure and ideology. One course. *Johns*

163. Women in Developing Societies. The diverse roles women played in third world countries prior to European contact, the subsequent transformation under colonial rule, and the current reassessment by the governments of developing societies. One course. *O'Barr*

165. Government and Politics of the Soviet Union. Analysis of the Soviet political system, emphasizing the sources of stability and instability and the responsiveness of its policies. Literature on the non-Soviet world (notably the United States) will be included. One course. *Hough*

168. Comparative Government and Politics: Northeast Asia I. Analysis of divergent responses to the West, the processes of political modernization, and national integration and instability. Emphasis on Japan and China. Nationalism and imperialism within Asia. One course. *McKean*

169. Comparative Government and Politics: Northeast Asia II. Revolution and nation-building in Northeast Asia. Manipulation of the political culture, and postwar political structures and processes in China, Japan, Taiwan, and Korea. One course. *McKean*

180S. Comparative Government and Politics: Southern Asia I. Concepts of political development in new states, using India, Pakistan, Ceylon, and Malaysia as case studies. Theory and practice of foreign aid and technical assistance as agents of political modernization. One course. *Braibanti*

181. Comparative Government and Politics: Southern Asia II. The political modernization of India and Pakistan since 1947. Constitutional developments as revealed in leading court judgments will be studied. Other topics will be the ideology of administrative reform, formulation of state polity, rural development, and party politics. One course. *Braibanti*

184. Canada: Problems and Issues of an Advanced Industrial Society. (Also listed as Interdisciplinary Course 184.) One course. *Preston and Visiting Lecturers*

195. Canadian Political Behavior in an American Perspective. Analysis of internal and external factors influencing political behavior in the urban-industrial, liberal-democratic society of Canada. One course. *Kornberg*

211. Contemporary Japanese Politics. Domestic themes in postwar Japan, including the institutional structure, the legal system, local government, political parties, interest groups, the traditional political culture, participation, and the emergence of citizenship. Previous work in East Asian history or politics recommended but not required. One course. *McKean*

213S. Canadian-American Relations. Analysis of the social, economic and political relations with emphasis upon Canadian response to United States policies. One course. *Staff*

214. Comparative Administrative Law. Comparative analysis of the role of administrative techniques in established and transitional constitutional systems. French, German, British, and American patterns. Control of legality and expediency of various types of judicial review. One course. *Grzybowski*

215. Comparative Legislative Processes. Analysis of the structures and functions of legislative institutions and of the behavior of legislative elites in both parliamentary and congressional systems. One course. *Mishler*

216S. Comparative Politics of the Welfare State. Analysis of the political processes that shape very different solutions to similar social problems in advanced industrial nations. Examination of the development of income-maintenance programs and health care systems, with some discussion of other social policies. One course. *Stone*

225. Comparative Government and Politics: Western Europe. Modern political institutions and processes in Western Europe. One course. *Cole*

235. The Commonwealth. Analysis of political relationships among the members of the Commonwealth and a comparative study of the political systems of the Commonwealth countries, with emphasis on Canada. One course. *Cole*

250. Comparative Government and Politics: Southern Asia. The political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional, and institutional aspects of the political systems. Impact of foreign technical assistance. One course. *Braibanti*

252. Comparative Political Behavior and Socialization. Elites and mass publics in a variety of Western and non-Western societies including the United States; models of the political socialization process and their implications for democratic theory. One course. *Mishler*

253. Comparative Government and Politics: Latin America. Current literature applicable to an understanding of the major themes of Latin American politics. One course. *Valenzuela*

271. Political Processes in Traditional and Modern Africa. Patterns of change in selected African societies from the pre-colonial to the post-colonial period, emphasizing the interaction between traditional, colonial, and post-colonial institutions and their impact upon African societies. One course. *Johns*

277. Comparative Party Politics. The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. Emphasis upon research techniques and objectives. One course. *Kornberg*

278. Canadian Political Behavior in the North American Context. Institutional processes and political behavior in Canadian and American societies. Impact of multi-partyism, federalism, political and cultural particularism, and the elite structure. One course. *Kornberg*

280. Comparative Government and Politics: Sub-Saharan Africa. Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. One course. *Johns*

293. Federalism. Theoretical and operational aspects of federal systems of government, focusing on the United States and Canada. One course. *Leach*

AMERICAN GOVERNMENT AND PUBLIC ADMINISTRATION

100. Politics of Liberties and Equality. Theory and development of the Bill of Rights and the Fourteenth Amendment with attention to Supreme Court decisions and cultural and political forces. One course. *Fish*

105. The Black American in Politics. Behavior of Black people in the American political system, with special attention to voting organizations and the Black power movement. One course.

108S. The American Presidency. The presidency and its impact on the American political system. One course. *Paletz*

109. State and Local Government Today. Problems in state, county, and city government. One course. *Leach*

111S, 112S-113S. Administration of Justice. (Also listed as Public Policy Studies 151S, 152S-153S.) Three courses. *Cook, Shimm and Brannon*

114S, 115S-116S. Communications Policy. (Also listed as Public Policy Studies 154S, 155S-156S.) Three courses. *DeVries, Lange and Broder*

125. American Political Parties and Practical Politics. A study of the historical development, organization, and methods of political parties in the United States. One course. *Mishler*

127. Law and Politics. Nature and functions of law; Anglo-American legal institutions, the process of judicial decision-making, and the relationships among judges, lawyers, legislators, and administrators in the development of public as well as private law. One course. *Fish*

128S. Congress and the Presidency. Policy-making in the executive and legislative branches of the U. S. government, with particular attention to intra-governmental relations. One course. *Price*

129. Groups in American Politics. Theory and practice of the interest group approach to the study of American politics. One course. *Paletz*

130. Politics and the Media of Mass Communication. Activities of the media of mass communication as they affect the American political system and process. Governmental impact on the mass media. One course. *Paletz*

134S. Problems in Communication. (Also listed as Public Policy Studies 108S.)

137. Political Behavior in Elections. Political participation; public opinion; voting behavior, sociological and psychological bases, comparative studies, models and methodology of research. One course. *Trilling*

139. Bureaucracy and Public Policy. Analysis of the role of American bureaucracy in the making and execution of public policy. One course. *Hall*

140. Administrative Law and Government. Fundamentals of the American system of law and government as reflected in the administrative process. One course. *Hall*

141. Public Administration. An introduction to the role of administration in the governmental process considering principles of administrative organization, methods of administrative control, personnel, and fiscal management. In general the study of the organizational and administrative problems encountered by any government agency charged with carrying out a public policy. One course. *Cleaveland or Hall*

142. Administrative Responsibility. An evaluation of political, legal, and administrative methods of achieving a responsible bureaucracy in American national government. Comparisons with relevant experience and techniques in other countries such as Great Britain and France. One course. *Hall*

145. Political Analysis for Public Policy-Making. (Also listed as Public Policy Studies 114.) One course. *Hawley or Stone*

170S. The Legal Process and Social Change. The role of the legal system in

effecting and mediating social change. Consideration of different strategies and the circumstances in which they are effective. One course. *Fleishman*

176. Urban Politics. Urban political processes and their impact upon urban policy. One course. *Salamon*

186. Political Leadership. The development, characteristics, and impact of political leaders. Biographical and collective studies are considered primarily from a psychological perspective. One course. *Barber*

188. The Psychology of Political Symbols. The role of symbolic political issues in determining public attitudes and voting behavior. Symbolic political issues such as "law and order," pornography, and prohibition, distinguished from public welfare issues such as employment policies. One course. *McConahay*

199. The Changing South. (Also listed as Interdisciplinary Course 199.) One course. *Staff*

206. Politics and the Media. The relationship between the media of mass communication and the American political process. Open to upperclassmen with permission of instructor. One course. *Paletz*

207. American Constitutional Interpretation. Development of the Constitution of the United States through Supreme Court decisions. Prerequisite: Political Science 127. One course. *Fish*

208. American Constitutional Development. One course. *Fish*

209. Problems in State Government and Politics. One course. *Leach*

210. The Politics of Education. The forces in local, state, and national politics which impinge on educational policy-making and administration. One course. *Leach*

230. American National Government. Formation and contemporary operation of the national political system; historical and behavioral approaches. One course.

241. Public Administrative Organization and Management. The American administrative process: theory and practice of administrative organization and management. One course. *Hall*

243. Administrative and Organizational Theory. Behavioral analysis of public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Also listed as Public Policy Studies 224.) One course. *Hawley*

244. Administrative Law and Process. The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. One course. *Hall*

245. Ethics and Policy Making. (Also listed as Public Policy Studies 223.) One course. *Price*

246. Administration and Public Policy. The role of administration in the American policy process. One course. *Hall*

247. Political Participation and Policy Outcomes. (Also listed as Public Policy Studies 247.) One course. *Hough*

248. The Politics of the Policy Process. (Also listed as Public Policy Studies 219.) One course. *Behn and Salamon*

273S. Modernization in the American South. Evaluates the usefulness of modernization theory in analyzing the historical roots of backwardness in the South and the dynamics of recent processes of social, economic, and political change. One course. *Salamon*

275. The American Party System. An intensive examination of selected facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, recent foreign policy and party alignments, and the controversy over party government. One course. *Kornberg*

279. The Legislative Process. An analysis of the structure and functions of Congress with emphasis on the behavior of legislators and resultant public policy. Some considerations will be given to American state and foreign legislatures. One course. *Paletz*

283S. Congressional Policy-Making. Lawmaking and oversight in the U. S. Congress. Committee roles. Impact of the executive and other external forces. (Also listed as Public Policy Studies 283S.) One course. *Price*

285. The Judicial Process. A study of judicial decision-making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisite: Political Science 127 or 207 or the equivalent. One course. *Fish*

291. Problems of Urban Government. One course. *Leach*

INTERNATIONAL LAW AND RELATIONS

120. Conflict Resolution: Problems of War and Peace. The causes and preconditions of human conflict including such factors as deprivation, elite misconceptions, national myths, and civil strife. Consideration of restraints to violent conflict such as negotiation and bargaining. Relevant contemporary international issues such as Vietnam are studied within the context of current social science research. One course. *Eldridge*

121. Elements of International Relations. The nature of international politics, the analysis of national power, the instruments of foreign policy, and the controls of state behavior. One course. *Ball, Eldridge, and O'Barr*

122. Modern International Politics. An examination of the major problems of postwar international politics with particular attention to the extension of Soviet power, the Western response to this challenge, and the revolutions in the Afro-Asian world. One course. *Eldridge and O'Barr*

157. U. S. Foreign Policy. An analytical survey of the source of and constraints upon American foreign policy. Prominent theories of American diplomacy in the light of external undertakings. One course. *Holsti*

158. U. S. Foreign Policy Decision-Making. Comparative analyses of crisis and noncrisis decisions since 1945. One course. *Holsti*

166. Soviet Foreign Relations. Nature of relations with other states. Determinants and formulation of foreign policy. One course. *Hough*

212. Japanese Foreign Policy. Japan's entrance into the international community. With emphasis on the postwar role. One course. *McKean*

220. Problems of International Politics. Nuclear weapons, deterrence, arms control and disarmament, alliances, and crisis management. One course. *Holsti*

221. International Organization. The functioning of the United Nations system and of regional organizations operating in the political and security fields. One course. *Ball*

226. Theories of International Relations. Contemporary theories of international relations and foreign policy. Emphasis on the interdependence of theory and empirical research. One course. *Eldridge*

227. International Law. Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. One course. *Grzybowski*

228. Soviet Public International Law. Institutions and doctrines of the international law of peace as interpreted and applied by the Soviet government. Basic concepts including the theory of socialist international law and principle of peaceful coexistence. One course. *Grzybowski*

237S. Problems in American Foreign Policy. The decision-making process as applied to contemporary foreign policy issues. Prerequisite: Political Science 122 or the equivalent. One course. *Ball*

238. Comparative Foreign Policy. An application of comparative theory to the foreign policy decision-making processes of major, middle range, and developing states. Prerequisite: one advanced course (100-level) in international relations and/or one course in comparative politics. One course. *Eldridge*

INDEPENDENT STUDY AND INTERNSHIPS

189, 190. Internship. Open to enrollment by students engaging in practical political or governmental work experience during the summer or a regular semester. To enroll a student must obtain the approval of the Director of Undergraduate Studies, arrange employment, and secure the agreement of a departmental faculty member to supervise a program of study related to the work experience. Two courses.

191, 192. Independent Study. Directed reading and research. Open only to qualified juniors by permission of the Director of Undergraduate Studies and of the individual instructor. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research. Open only to seniors by permission of the Director of Undergraduate Studies and of the individual instructor. Two courses. *Staff*

UNDERGRADUATE SEMINARS

Intermediate Seminar. One-hundred-level courses designated in the class schedule with an S will be limited in enrollment to a maximum of fifteen students and conducted as seminars. Different courses will be so designated in different years. Consult the official class schedule issued at the beginning of each semester for those currently being offered.

Senior Seminars in Political Science. Prerequisites: Political Science 61 or 61D and one 100- or 200-level course in the field represented by the seminar,

and the permission of the instructor. Preference given to majors. Each seminar will not necessarily be offered every year. Consult the official class schedule.

200S A. Seminar in American Government and Politics. One course. *Staff*
200S B. Seminar in Comparative Government and Politics. One course. *Staff*
200S C. Seminar in Political Theory. One course. *Staff*
200S D. Seminar in International Relations. One course. *Staff*

198. Seniors Honors Seminars. Open only to senior political science majors who are candidates for the degree with distinction. Preparation and writing of a research paper; group meetings to discuss common problems. Prerequisites: Political Science 197 and permission of the instructor. One course. *Staff*

DEPARTMENTAL MAJOR

Major Requirements. Political Science 61 or 61D. Seven courses in the department above 61 or 61D including two 200-level courses or 200-level seminars. Majors must take at least one course in each of three fields. Four related courses in departments approved by the political science adviser. Such courses are usually taken in the Departments of Economics, History, Philosophy, Psychology, and Sociology.

Honors. Any student who is qualified (see the section on Honors in this *Bulletin)* may undertake work leading to a degree with distinction in political science by presenting himself to the Director of Undergraduate Studies as a candidate. In addition to meeting the normal requirements of a major in the department, the candidate for graduation with distinction must take Political Science 197 and 198. He must prepare a research paper on which he will be examined orally by a committee of three faculty members.

Psychology

Professor Alexander, *Chairman;* Professor Wing, *Director of Undergraduate Studies;* Professors Bevan, Borstelmann, Brehm, Carson, Diamond, R. Erickson, Guttman, Jones, Lakin, Lockhead, H. Schiffman, Staddon, and M. Wallach; Visiting Professor Campbell; Associate Professors Coie, Costanzo, C. Erickson, Hall, and McConahay; Visiting Associate Professor Conger; Assistant Professors Aderman, Eckerman, Fischer, Kalat, Kremen, Levy, Norton, Robinson, Roth, and White; Lecturers Burkheimer, Casseday, Clifford, E. Crovitz, H. Crovitz, Davis, Gehman, Gentry, Oppenheim, Peele, Shows, Somjen, L. Wallach, and Wolbarsht; Adjunct Instructor Musia Lakin; Research Associate S. Schiffman

70S, 71S. Freshman Seminars. Intensive experience through the study of one or two problems of special interest; does not fulfill departmental prerequisites. Prerequisite: departmental permission. Half-course or one course each. *Staff*

The following 4 first-level courses are open to freshmen, sophomores, juniors, and seniors without prerequisite. Some of these courses will have discussion sections or preceptorials, with the availability of these experiences to be specified prior to registration. Students in each of these courses are expected to participate as subjects in 3-6 hours of psychological research. An individual student need fulfill this requirement only once, even though he takes more than one course at this level.

102. Sensation, Perception, and Learning. Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sher-

rington) and behavioral (Pavlov). Complex organization: learning, perception, and cognition. One course. *Guttman, Lockhead, Schiffman, or Staddon*

103. Biological Basis of Behavior. Behavior as a product of evolution and the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. *Diamond, C. Erickson, or Kalat*

104. Personality. Representative theories of personality, from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. One course. *Alexander, Carson, or Kremen*

105. Developmental Psychology. Theory and research on growth and behavior from infancy to adolescence. One course. *Borstelmann, Coie, Costanzo, or Eckerman*

Intermediate and Advanced Lecture Courses. Some of these offerings will include discussion sections or preceptorials, as specified prior to registration.

110. Applied Psychology. Applications of psychology to problems of personnel selection, industrial efficiency, advertising, and selling. Prerequisite: one course in psychology. One course. *Staff*

111. Social Psychology. Problems, concepts, and methods in the study of social interaction and interpersonal influence. Prerequisite: Psychology 102, 103, 104, or 105 or permission of the instructor. One course. *Aderman or Jones*

117. Statistical Methods in Psychology. Elementary statistical techniques and their application to the analysis and interpretation of psychological data. Theory of inference is stressed. Psychology majors only. One course. *Staff*

122S. Seminar in Child Observation. Children are observed in the group setting of the University Preschool and Primary Program. Aspects of personality, social development, and child-adult relationships. Open only to junior and senior psychology majors with the permission of the instructor. One course. *Musia Lakin*

131. Visual Perception. Structure and function of visual systems, perception of form and brightness, color vision, depth perception, adaptation, and perceptual development. Prerequisite: Psychology 102 or 103 or permission of the instructor. One course. *White*

132. The Psychology of Individual Differences. Nature and causes of individual and group variations in intelligence, special abilities, social and emotional characteristics. Prerequisite: one course in psychology. One course. *Wing*

133. Biological Aspects of Learning. Evolution of learning abilities; specialized learning abilities; physiological mechanisms of learning. Prerequisite: Psychology 102 or 103. One course. *Kalat*

134. Psychology of Language. An integrative, theoretical approach to psycholinguistics stressing the relation of language and speech to other areas in psychology. One course. *Robinson*

137. Physiological Basis of Perception. Basic concepts and current theories on the neural mechanisms involved in the processing of sensory information. Prerequisite: Psychology 102 or 103. One course. *Norton*

138. Abnormal Psychology. Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 104 or 105. One course. *Carson or Lakin*

Laboratory Courses (140 through 149). These courses are open chiefly to juniors and seniors. The subject matter varies, but these courses have in common a concern with the design and execution of psychological experiments. Students will find them helpful as a means of gaining experience before engaging in independent study.

140S. Research Methods in Child Psychology. Prerequisite: Psychology 105. One course. *Coie, Eckerman, or L. Wallach*

141S. Tests and Measurements. Test methods used by psychologists to measure and evaluate mental processes. Prerequisite: Psychology 117 or the equivalent. One course. *Schiffman or Wing*

142S. Instrumental Behavior. Laboratory course using animal subjects in operant-conditioning situations. Prerequisite: Psychology 102. One course. *Guttman or Staddon*

143S. Experimental Methods in Cognitive Psychology. Human cognition; language, memory, problem-solving, and other higher mental processes. One course. *Staff*

144S. Learning and Adaptive Behavior. Basic principles of adaptive behavior in animals, with special emphasis on the effects of reinforcement. Participation in experiments with animals. Prerequisite: Psychology 102 or 103, or permission of the instructor. One course. *Staddon*

145S. Experimental Approaches to Personality. Methods applied to personality research. Prerequisite: Psychology 104. One course. *Costanzo, Schiffman, or Wallach*

146S. Experimental Comparative Psychology. Animal behavior from evolutionary and physiological viewpoints. Emphasis on methodology. Prerequisite: Psychology 102 or 103. One course. *C. Erickson or Kalat*

147S. Experimental Social Psychology. Group dynamics, attitude change and interpersonal perception. Prerequisite: Psychology 111. One course. *Aderman, Brehm, or Jones*

148S. Psychology of Perception and Thinking. Basic phenomena of perception and thinking as determined by conditions in the external situation and in the person—biological and psychological. Prerequisite: Psychology 102. One course. *H. Crovitz, Lockhead, or White*

149S. Physiological Psychology Laboratory. Neural bases of behavior, sensory and motor functions of the nervous system, and problems of emotion, motivation, and consciousness. Laboratory in psychophysics and the electrical activity of the nervous system. Prerequisite: permission of instructor. One course. *R. Erickson*

152S. Psychological Approaches to Contemporary Problems. Relevance of various psychological theories and findings to selected contemporary issues. Prerequisite: permission of the instructor. One course. *Staff*

154S. Education, Children, and Poverty. Psychological hypotheses concerning the roles of preschool intervention programs, improved quality of resources, teacher expectancy effects, and enhancement of pupil self-confidence, in relation to the goal of improved cognitive competence for poverty background children. Criteria for defining competence, such as scores on psychometric intelligence tests, performing on Piagetian tasks, and development of specific skills. Interpretations concerning intelligence and cognitive deprivation

in poor children in the light of relevant psychological evidence. Prerequisite: one course in psychology or permission of instructor. One course. *M. Wallach*

165S. Personality Theory. Theories of personality from larger metatheoretical perspectives. Open to junior and senior majors in psychology, or by permission of the instructor. Prerequisite: Psychology 104. One course. *Alexander or Kremen*

170S. A-D. Seminar in Selected Problems. One course each. *Staff*

Tutorial Study. For juniors and seniors. Small group discussions about influential books and articles in psychology. The availability of tutorials, their content, and their instructors will be announced before registration.

171T, 172T. Junior Tutorial. Prerequisites: Psychology 102 or 103, Psychology 104 or 105, and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

173T, 174T. Senior Tutorial. Prerequisites: Psychology 102 or 103; Psychology 104 or 105; Computer Science 51 or Mathematics 32, 133, 135, 136, or Psychology 117 or the equivalent; and permission of the Director of Undergraduate Studies. Half-course or one course. *Staff*

177, 178. Independent Research. Admission to the course requires formulation of a study plan with a faculty supervisor and approval of the Director of Undergraduate Studies. Prerequisites: Psychology 102 or 103, Psychology 104 or 105, and one psychology course numbered 140 through 149; Mathematics 133 or Psychology 117 will be helpful. One or two courses. *Staff*

191, 192. Junior Independent Study and Research. Directed reading and research. Open only to highly qualified juniors who expect to graduate with distinction in psychology. Prerequisite: permission of the department. One or two courses. *Staff*

193, 194. Senior Independent Study and Research. Directed reading and research for seniors planning to graduate with distinction in psychology. Prerequisite: permission of the department. One or two courses. *Staff*

Courses at the 200-level are open to selected undergraduates only with written permission of the instructor.

203. Sensation and Perception. An examination of the classical concepts in sensation and perception and of the resulting psychophysical data for each of the major senses with emphasis on vision and audition. Modern perceptual formulations are discussed through analysis of the empirical evidence in support of each view. One course. *Lockhead*

206. Comparative Psychology. Eminent comparative psychologists and their work. One course. *Kalat*

210. Cognitive Psychology. Theoretical approach; stresses interconnections across perception, memory, thinking, language, and use of models. One course. *Robinson*

213. Adaptive Behavior. The principles of adaptive behavior, with special emphasis on the effects of reinforcement. Prerequisite: permission of instructor. One course. *Staddon*

215. Developmental Psychology. Theories of human development. One course. *L. Wallach and Staff*

216. Biological Psychology. The methods of biology (as applied to psychology), especially in neurophysiology, neuroanatomy, and genetics. Topics covered include: the genetics of behavior, the organization of the dorsal thalamus and neocortex, and the limbic system and hypothalamus. Methods covered include: ablation method, method of evoked potential, electrical stimulation of the brain, and classical and physiological genetics. One course. *Diamond*

217. Social Psychology. Social factors in cognition, models of social interaction, conformity and social influence, and attitude development and change. One course. *Jones*

218. Research Methods in Social Psychology. Emphasis on the interplay between experimental design and technique. One course. *Aderman*

219. Neural Bases of Behavior. Structure and function of the nervous system as related to problems of sensory-motor processes, learning, and memory. One course. *R. Erickson*

228. Visually Guided Behavior. Anatomical and physiological maturation of the nervous system structures mediating visual behaviors. How the maturation of the visual pathway may contribute to the development of these behaviors. One course. *Norton*

230. Social Behavior of Animals. Developmental, ecological, and physiological aspects of territorial, sexual, parental, and aggressive behavior. One course. *C. Erickson*

234. Seminar in Personality. Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. One course. *M. Wallach*

245. Personality Theory I. Representative theories of human functioning, from Freud to neoanalytic approaches. One course. *Alexander or Kremen*

246. Personality Theory II. Representative models of human functioning, as field theory, behavior theory, type or trait theory, and ego psychology. One course. *Alexander or Kremen*

271S. Selected Problems. One course. *Staff*

273-274. Principles of Psychological Measurement. Measurement theory and the problems of scientific inference. Methods of data analysis, psychometric scaling, and test construction. Prerequisite: permission of instructor. Two courses. *Schiffman*

276. Neuroanatomical Basis of Sensory Physiology. Original papers are read and discussed which are concerned with the neuroanatomical substrates underlying sensory processing in the auditory and visual systems. One course. *Hall*

282. Introduction to Methods in Psychotherapy. Current trends in psychotherapeutic practice and research. Application of principles drawn from theories of personality to individual and group psychotherapy. Prerequisite: permission of instructor. One course. *Carson or Martin Lakin*

283, 284. The History of Psychology. First semester: Aristotle to Kant; second semester: development of modern psychology. Prerequisite for 284: Psychology 283 or permission of instructor. One course or two courses. *Guttman*

291. Seminar in Community Mental Health. Psychological epidemiology and ecology; primary, secondary, and tertiary prevention; the public health ap-

proach to problems of psychological disorders and psychological well-being. Focus on intervention techniques, such as consultation and community action planning. One course. *Staff*

293. Methods in Developmental Psychology. Methodological and epistemological issues in research in development. Individual and group research projects. One course. *Staff*

DEPARTMENTAL MAJOR

Major Requirements. Eight courses in psychology, including 102 or 103 and 104 or 105, Psychology 117, plus 5 additional psychology courses of the student's selection. Mathematics 32, 135, 136, Computer Science 51, or Management Science 60 may be substituted for Psychology 117 but do not count as 1 of the 8 required psychology courses.

Students seeking a B.S. degree must complete, in addition to the above requirements, a minimum of two calculus courses in mathematics and 6 additional courses in the natural sciences or mathematics.

Public Policy Studies

Professor Fleishman, *Director;* Associate Professor Hawley, *Associate Director;* Assistant Professor Cook, *Director of Undergraduate Studies;* Professors Estes (Medicine) and Hough (Political Science); Adjunct Professor Lange (Law); Associate Professors Behn, McConahay, and Price; Assistant Professors Bell (Law), Fischer, Salamon, and Vaupel; Adjunct Assistant Professor Scheffler; Lecturers Lipscomb, Payne, and Stone

The policy sciences major is an interdisciplinary social science program designed to provide students with the skills, analytical perspectives, and descriptive information which policy analysts need to deal effectively with major contemporary social problems. The course of study familiarizes the student with the kind of contribution each of several disciplines (political science, economics, social psychology, applied mathematics, and the humanities) can make to policy analysis. Opportunities are provided, both in the classroom and through field experiences, for students to integrate this material and apply it to analyzing specific public policy issues.

The students majoring in public policy are able to participate in a variety of learning experiences including seminars, lecture discussion classes, individual study, policy workshops, and an internship. In addition, students are urged to participate actively in numerous programs sponsored by the Institute which supplement the material covered in class. As a matter of policy, students are asked to evaluate teaching and course content and are provided both formal and informal opportunities to shape the Institute's program and curriculum.

Courses in public policy are open to all students providing that the prerequisites (if any) cited for individual courses are met.

55. Analytical Methods for Public Policymaking: Structuring Policy Problems. Methods of decision analysis for structuring complex decision problems, forecasting the probabilities of outcomes, and appraising the desirability of various decision alternatives. One course. *Behn, Fischer, or Vaupel*

110. Economic Analysis for Public Policymaking: Microeconomic and Non-Probabilistic Models. The application of microeconomic analysis to various public policy areas, including agriculture, housing, taxation, and income redistribution. Prerequisite: Economics 52 or equivalent. One course. *Cook or Lipscomb*

112. Policy Evaluation and Social Experimentation. The uses and limitations of various statistical methods, including social experimentation, for monitoring and evaluating public policies. Prerequisite: Public Policy Studies 55. One course. *Behn, Fischer, or McConahay*

114. Political Analysis for Public Policymaking. Analysis of the political and organizational processes which influence the formulation and implementation of public policy. Alternative explanatory models. (Also listed as Political Science 145.) One course. *Hawley or Stone*

116. Policy Choice as Value Conflict. Theoretical and practical problems in decision-making in relation to conflicts of value and of interest. Professional ethics, ideology, law, and other sources of norms in relation to such topics as welfare, environment policy, and decisions during the Vietnam War. (Also listed as Political Science 133.) One course. *Payne*

174. Technology Assessment and Social Choice. Engineering, economic, psychological, and ethical problems in designing technological systems. Citizen participation and feedback; impact evaluation; case studies in areas such as biomedical, communications, and computer technology. (Also listed as Engineering 174.) One course. *Garg and Clark*

183. American Journalism in Conflict. Fundamental issues in American journalism from perspectives of the newsman, the official, and the public. Conflicts between an adversary press and claims of national security; public access to the media; protection of news sources; advocacy and contemporary political reporting. Case studies of current interest. One course. *Staff*

184S. The Mass Media's Effect on Political Attitudes. Impact of mass media, particularly television, on the development of political attitudes. Students will design and conduct research on various "theories" of the influence of the media. One course. *Vanocur*

190. Internship. Open to students who are working in a public agency, political campaign, or other policy-oriented group under the supervision of a faculty member. One course. *Staff*

191, 192. Independent Study. Directed reading and research. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for seniors. Two courses. *Staff*

217. The Application of Microeconomics to Public Policymaking. Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision-making. One course. *Cook or Lipscomb*

219. The Politics of the Policy Process. The formulation of public policymaking conditions, substantive policies in a variety of contexts from local government to international affairs; the role of legislatures, interest groups, chief executives, and the bureaucracy in defining alternatives and in shaping policy from agenda formulation to implementation. (Also listed as Political Science 248.) One course. *Behn or Salamon*

221. Analytical Methods I: Forecasting Consequences of Policy Alternatives. The decision analysis approach as a strategy for policymaking; uses and limitations of deterministic, probabilistic, unitary, and interactive models for guesstimating the consequences of policy alternatives, including modeling tech-

niques for structuring policy problems and statistical techniques for gathering and processing data for models. One course. *Fischer or Vaupel*

222. Analytical Methods II: Appraising Consequences of Policy Alternatives. Various methods for appraising and weighing the consequences of policy alternatives, including the uses and limitations of economic utility theory, probabilistic preference theory, time preferences, multi-attribute preference tradeoffs, cost/effectiveness analysis, cost/benefit analysis, scoring systems, performance indices, objective functions, indifference curves, Pareto optimality, market and shadow prices, willingness to pay, consumer's surplus; concludes with a discussion of some formal decision analysis and mathematical programming. Prerequisite: Public Policy Studies 221. One course. *Fischer or Vaupel*

223S. Ethics and Policy-making. Normative concepts in politics—liberty, justice, the public interest—in terms of historical and philosophical roots and implications for domestic policy. Prerequisite: permission of instructor. (Listed also as Political Science 245.) One course. *Price*

224. Administrative and Organizational Theory. (Listed also as Political Science 243.) One course. *Hawley*

247. Political Participation and Policy Outcomes. Impact of citizen participation upon governmental decision-making. Theoretical issues and empirical evidence (primarily American, but partly comparative). (Listed also as Political Science 247.) One course. *Hough*

252S. National Security Policy. Application of normative and organizational theory and historical systems, and decision analysis to major strategic decisions and selected foreign policy issues. One course. *Fischer*

260S. Research Seminar: the Administration of Justice I. One course. *Staff*

261S. Research Seminar: Health Policy I. One course. *Lipscomb and Stone*

262S. Research Seminar: Communications I. One course. *Staff*

270S. Humanistic Perspectives on Public Policy. Aspects of social life important to policy makers but beyond the normal reach of social science. Readings from James Agee, Robert Coles, Eudora Welty, James Baldwin, George Eliot, and others. Prerequisite: permission of instructor. One course. *Payne*

283S. Congressional Policy-Making. Lawmaking and oversight in the United States Congress. Committee roles. Impact of the executive and other "external" forces. (Listed also as Political Science 283.) One course. *Price*

INTERNSHIP COURSES

The Institute's internship courses provide students with an opportunity to develop a basic understanding of one or more public policy areas, to test that understanding on the job during the summer (stipends are provided for students who qualify for financial assistance), and to return to the classroom to build on this knowledge and experience. Except under unusual circumstances, students must take the entire course sequence to receive credit for any part of an internship course. Students interested in internships in other policy areas, other than those listed below, should contact the Director of Undergraduate Studies in Public Policy. Applications for enrollment in the internship courses must be obtained in the early fall from the Director of Internship Programs (120 Old Chemistry).

146S, 147S-148S. Public Policy and Poverty in the South. Analysis of al-

ternative strategies for mitigation of poverty in both urban and rural settings, theories to explain poverty, relationship between urban and rural deprivation, and existing federal, state, and local policy aimed at the poor. *Hawley*

151S, 152S-153S. Administration of Justice. Analysis of the policy problems and conflicts involved in the operation of the criminal justice system. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructor's permission required except for those majoring in public policy studies. (Also listed as Political Science 111S, 112S-113S.) *Staff*

154S, 155S-156S. Communications Policy. Considerations and analysis of the policy problems and conflicts involved in governmental regulation of the media of communication. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructor's permission required except for those majoring in public policy studies. (Also listed as Political Science 114S, 115S-116S.) *Staff*

157S, 158S-159S. Health Policy. Analysis of health care problems and policies. Three sequential courses; spring, summer (including internship), and fall, respectively. Instructor's permission required except for those majoring in public policy studies. *Scheffler, Estes, or Staff*

THE MAJOR

Prerequisites. Economics 2 or 52, Political Science 61, and Public Policy Studies 55.

Major Requirements. Public Policy Studies 110, 112, 114, 116, plus three additional courses (including at least one outside of an internship sequence) and a policy-oriented field experience approved by the director of undergraduate studies.

Religion

Professor Poteat, *Chairman;* Associate Professor Kort, *Director of Undergraduate Studies;* Professors Bradley, Jones, Long, Osborn, Phillips, and Price; Associate Professors Clark, Lawrence, McCollough, Meyers, Partin, and Wintermute; Assistant Professors Bland, Burford, Charlesworth, and Corless; Visiting Assistant Professor Smith; Lecturers Breytspraak and Shows

The academic study of religion is integral to a liberal education. The curriculum is determined by the subject around which the department is formed, by the various areas and methods for the study of religion, and by the department's desire to increase and discipline the students' understanding of and appreciation for those religious phenomena and problems brought into focus by each area and method.

In addition to Biblical studies and studies in Christian history, ethics, and theology, the department offers courses in Judaic and non-Western religious studies as well as courses of a substantially interdisciplinary character.

Courses numbered below 100, with the exception of Religion 70S and Religion 71S, are open to all students. Religion 70S and 71S are freshman-sophomore seminars. One-hundred-level courses are open to juniors and seniors without prerequisites except in the cases in which the requirement of permission of the instructor is stated at the end of the course description. Freshmen and sophomores who have completed one course below 100 may be admitted to 100-level courses with the exception of junior-senior seminars. Courses at the 200-level are open to upperclassmen with the permission of the instructor.

50. The Old Testament. Historical, literary, and theological investigations. Not open to students who have had Religion 55 or 55D. One course. *Staff*

52. The New Testament. Origins, development, and content of thought. Not open to students who have had Religion 55 or 55D. One course. *Staff*

55. The Religion of the Bible. A historical, cultural, and theological study of the Old and New Testaments. Not open to students who have had Religion 50, 50D, 52, or 52D. One course. *Staff*

50D, 52D, 55D. Same as 50, 52, 55 with discussion section included. One course. *Staff*

57. Introduction to the History of Religions. Historico-religious study of primitive religions. Hinduism, Buddhism, Islam, and other religions. One course. *Staff*

59. Problems in Theology and Ethics. Philosophical, theological, and cultural problems, such as the existence of God, ethical theory, religious language, and the relation of religion to culture. One course. *Staff*

70S, 71S. Freshman-Sophomore Seminars: Religious Studies. Topics and instructors to be announced. Two courses.

BIBLICAL STUDIES

104. The Prophets of the Old Testament. Their historical setting and message. One course. *Wintermute*

105. Theology of the Old Testament. Emphasis upon history and eschatology, covenant, messianism, and wisdom. One course. *Staff*

106. Jesus and the Synoptic Gospels. The gospel tradition in the New Testament. One course. *Charlesworth or Price*

107. Theology of the New Testament. A systematic analysis of the theologies of the New Testament writers and an attempt to synthesize the basic and shared themes. One course. *Charlesworth or Price*

108. The Life and Letters of Paul. Paul's role in the expansion of the Christian movement, the most important aspects of his thought, and his continuing influence. One course. *Charlesworth or Price*

111. The Historical Jesus. Historical research on the life of Jesus. One course. *Charlesworth or Price*

115-116. Introduction to Biblical Hebrew. (Divinity School courses open to undergraduates with permission of the instructor.) Elements of phonology, morphology, and syntax. Exercises in reading and writing Hebrew. Second semester: study of the weak verb; exegetical treatment of the book of Jonah. Two courses. *Bailey*

195A, 196A. Junior-Senior Seminars: Biblical Studies. Topics and instructors to be announced. Two courses.

207, 208. Second Hebrew. (Also listed as OT207, OT208 in the Divinity School.) Historical Hebrew grammar with reading and exegesis of Old Testament prose and poetry. Prerequisite: at least one year of Hebrew or permission of the instructor. Two courses. *Staff*

220. Third Hebrew. An interpretive study of late Hebrew prose, with readings from Chronicles, Ecclesiastes, and the Mishnah. One course. *Meyers*

221. Readings in Hebrew Biblical Commentaries. Selected Hebrew texts in Midrash, Aggadah, and other Hebrew commentaries reflecting major trends of classical Jewish exegesis. One course. *Bland*

228. Theology of the Gospel and Epistles of John. A study of the origin of these writings, the provenance of their thought forms and symbolism, their influence on the early church, and their contemporary significance. One course. *Price*

239. Introduction to Middle Egyptian. Grammar and readings in hieroglyphic texts relating to the Old Testament. One course. *Wintermute*

258. Coptic. Introduction to the Sahadic dialect with selected readings from Christian and Gnostic texts. Prerequisite: one year of Greek or permission of the instructor. One course. *Wintermute*

Students interested in acquiring additional linguistic tools required for graduate courses in Biblical studies are referred to the offerings of the Classics Department for elementary Greek and the *Divinity School Bulletin* for courses in Aramaic.

HISTORY OF CHRISTIANITY AND JUDAISM

120. History of the Christian Church. Crucial events, issues, forms, and writings that have shaped the Christian community and influenced Western civilization from the time of the early church. One course. *Jones.*

121. Christianity in Europe from the Middle Ages to the Protestant Reformation. The decline of the medieval Church and the origins of the Protestant Reformation. One course. *Staff*

122. Protestantism and Catholicism in Modern Europe. Reformation and Counter-Reformation, confessionalism, religious conflicts, and the secularization of European Christianity. One course. *Staff*

124. Christianity in America. Representative men, movements, and thought in American Christianity. One course. Jones

125. Religion and Theology of Black America. Black religion in its historical and social context, with critical appraisal of major works. One course. *Burford*

126. Themes in Christian Theology. Study of Christian teachings concerning God, Jesus Christ, sin, and salvation; intended to serve as a basis for the student's evaluation of his own religious concepts. One course. *Osborn*

128. The Background of Contemporary Christian Thought: 1918-1950. Theology of Karl Barth, Rudolf Bultmann, Paul Tillich, Karl Rahner, Reinhold Niebuhr, and others. One course. *Osborn*

129. The Frontiers of Contemporary Christian Thought. Radical and prophetic movements as represented by Dietrich Bonhoeffer, Harvey Cox, Leslie Dewart, Jurgen Moltmann, and others. One course. *Osborn*

130. Christian Ethics. Ethical implications of biblical religion, the historical development of the Christian ethics, and the ethical dimensions of contemporary social life. One course. *Clark or McCollough*

131D. Principles of Archaeological Investigation. Supervised field work, visits to other excavations, introduction to ceramic chronology, numismatics, and other related disciplines. Excavation of a late Roman village in Galilee. Offered in Israel, only in the summer. One course. *Meyers*

132D. Palestine in Late Antiquity. The history, literature, and archaeology of Roman Palestine with particular emphasis on Galilee in rabbinic and early Christian times. One course. *Meyers*

133. The Foundations of Post-Biblical Judaism. History, religion, and literature of Pharisaic and sectarian Judaism from the time of Ezra to Rabbi Judah. One course. *Meyers*

134. Jewish Mysticism. The main historical stages, personalities, texts, and doctrines from rabbinic to modern times. One course. *Bland*

135. Jewish Religious Thought. Doctrines, dialectics, and religious attitudes of pre-Enlightenment theologians. One course. *Bland*

136. Contemporary Jewish Thought. Modern Jewish thought from Mendelsohn to the present, with particular reference to American thinkers. One course. *Meyers*

137. Structure and Theology of Jewish Prayer. Historical and thematic analysis of the liturgical cycle. One course. *Bland*

139. Modern Hebrew. Representative texts from the modern period, with an introduction to the colloquial language of Israel. One course. *Staff*

195B, 196B. Junior-Senior Seminars: Studies in Christianity. Topics and instructors to be announced. Two courses.

195C, 196C. Junior-Senior Seminars: Judaic Studies. Topics and instructors to be announced. Two courses.

238. Jewish Responses to Christianity. Apologetic and polemical themes in rabbinic, medieval, and contemporary writings. One course. *Bland*

244. The Archaeology of Palestine in Hellenistic-Roman Times. The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. One course. *Meyers*

248. Theology of Karl Barth. A historical and critical study of Barth's theology. One course. *Osborn*

249. Doctrine of the Church in Contemporary Theology. One course. *Osborn*

HISTORY OF RELIGIONS

113. African Philosophy. (Also listed as Black Studies 113.) One course. *Olela*

140. Religions of India. Major religious traditions of the subcontinent. Hinduism, Buddhism, Jainism, and Islam. One course. *Lawrence*

141. Religions of China and Japan. Traditional religion in China and Japan and its interaction with Sino-Japanese Buddhism. One course. *Corless*

142. Myth and Symbol. Historical and phenomenological study of religious myths and symbols, Christian and non-Christian. One course. *Partin*

143. Mysticism. The mystical element in religion: Hinduism, Buddhism, Christianity, and Islam. One course. *Bradley*

145. Religious Quests of the Greco-Roman World. Sectarian Judaism, the Mystery Cults, and Gnosticism. One course. *Wintermute*

147. Muhammad and the Qur ān. The Qur ān in relation to the religious experience, life, and work of Muhammad. One course. *Partin*

148. Introduction to the Civilization of Southern Asia. (Also listed as Interdisciplinary Course 101.) One course. *Staff*

149. Buddha and Buddhism. A systematic introduction to the origins and spread of Buddhist thought and practice. One course. *Corless*

195D, 196D. Junior-Senior Seminars: History of Religions. Topics and instructors to be announced. Two courses.

217. Islam in India. History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millenium A.D. One course. *Lawrence*

218. Religion in Japan. A survey of religion in Japan, with specific emphasis on indigenization and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. One course. *Corless*

272S. Topics in Comparative Theology. Theological categories in Christian and Eastern religious traditions, focusing on such topics as man, God, salvation, and eschatology. One course. *Lawrence and Osborn*

280. The History of Religions. A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. One course. *Partin*

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions, with particular attention to religious pilgrimage. One course. *Partin*

283. Religions of East Asia. Major traditions of China and Japan; emphasis on Buddhism. One course.

284. The Religion and History of Islam. Origins and development of the Islamic community and tradition, with particular attention to the religious element. One course. *Partin*

285. The Vedic Tradition: Compilation and Interpretation. Indian canonical writings with emphasis on the literary stages in relation to later philosophical and religious movements. One course. *Lawrence*

286. Religious Trends in Modern India. Leaders and movements among the religions from the coming of the Europeans to Independence. One course. *Bradley*

287. The Scriptures of Asia. Translations of basic texts from the religious traditions of India, China, and Japan. One course. *Bradley*

288. Buddhist Thought and Practice. A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. One course. *Corless*

289. World Religions and Social Change. The contemporary role of Buddhism, Christianity, and Islam in Asia and Africa. One course. *Bradley*

RELIGION AND THE SOCIAL SCIENCES

150. Religion and Human Sexuality. A study of the current sexual revolution with the aim of examining options and determining relevant Judaic and Christian attitudes and actions. One course. *Phillips*

151. Ethical Issues in Social Change and Public Policy. American moral tradition and factors in social change in the normative analysis of public policy, with a consideration of specific ethical issues. One course. *McCollough*

154. Ethics and Modern Technology. Emerging ethical issues created by the impact of technology on the psychological, social, political, and economic life of modern man. One course. *Clark*

155. Ethical Issues in the Life Cycle. Human development viewed in religious, ethical, and psychological perspectives. One course. *McCollough*

156. Christian Marriage and the Family. Marriage and the family in American society studied from the Christian perspective. Attention will be given to the teachings of the churches and of psychologists and sociologists concerning courtship and marriage, sex, parent-child relationships, mixed marriages, and divorce. One course. *Phillips*

158. Psychology and Religion. Contributions of major psychological theories to an understanding of religion, especially Christianity. One course. *Shows*

195E, 196E. Junior-Senior Seminars: Religion and the Social Sciences. Topics and instructors to be announced. Two courses.

293. Sociological Analysis of Religion. Components of a religion (belief-systems, liturgical practices, ethical teachings, institutional structure, and modes of operation) as they function in relation to social cohesion, social conflict, and social reform. One course. *Clark*

294. Institutional Analysis of Religious Bodies. Internal structure and dynamics of religious groups. One course. *Clark*

295. Ethics and Economic Life. Historical teachings of the Christian churches in the area of economic life, contemporary norms of economic justice, and current public and private economic policies and policy-making processes. One course. *Clark*

RELIGION AND THE HUMANITIES

170. Problems of Religious Thought. Analysis of credentials for belief in God. One course. *Poteat*

174. Religion and The Poetics of Vision. The liturgical shaping of life as embodied in selected works of painting and sculpture. One course. *Poteat*

178. Existentialism. Religious roots, development, and contemporary expressions. One course. *Burford*

187. Religious Elements in Classical and European Literature. A consideration of the religious elements in representative writings. One course. *Kort*

188. Recent Literature and its Religious Implications. Religious elements in recent literature. One course. *Kort*

195F, 196F. Junior-Senior Seminars: Religion and the Humanities. Topics and instructors to be announced. Two courses.

232. Religion and Literature: Perspectives and Methods. Selected literary works as interpreted by myth or archetype critics and by theological critics. One course. *Kort*

233. Modern Narrative and Religious Language. Fiction of selected American, British, and continental writers of the first half of the twentieth century,

with special attention to the role of religious language in their work. One course. *Kort*

INDEPENDENT STUDY

191, 192. Independent Study. For freshmen and sophomores with departmental approval. Two courses. *Staff*

193, 194. Independent Study. For juniors and seniors with departmental approval. Two courses. *Staff*

DEPARTMENTAL MAJOR

Major Requirements. Eight courses, which must include one course in each of at least three of the five areas of the curriculum (it is recommended that biblical studies and history of religions be two of these three areas). The 8 courses must include 2 courses at the introductory level (50, 52, and 55 in the area of biblical studies; 57 in history of religions; 59 may count in any of the three remaining areas) and a junior-senior seminar or a 200-level course. Knowledge of a foreign language is recommended.

Reserve Officers Training Program

AIR FORCE AEROSPACE STUDIES

Professor Knops, Lt. Colonel, USAF, *Chairman;* Associate Professor Griffin, Major, USAF, *Director of Undergraduate Studies;* Assistant Professor Weeks, Captain, USAF, *Supervisor of Freshman Instruction*

Eligibility Requirements. All freshmen, male or female, are eligible to enroll in the General Military Course in the Air Force ROTC. For enrollment in the Professional Officer Course, the student must have completed successfully either the General Military Course or the six weeks Field Training Course; must execute a written agreement with the government to complete the Professional Officer Course; must be sworn into the Enlisted Reserve; and he must agree to accept a commission in the United States Air Force Reserve upon graduation.

Deposit. Each student must make a deposit of $10 with the Bursar's Office to ensure the return of all government property.

General Military Courses

First Year

1. Defense of the United States. A study of the causes of world conflict, the problem of United States security, and the role of the armed forces as instruments of national policy. (May not be counted to satisfy graduation requirements.) Half-course. *Weeks*

4. Corps Training. No course credit. *Staff*

Second Year

51. Growth and Development of Aerospace Power. This course deals with the development of air power from dirigibles and balloons through the present. (May not be counted to satisfy graduation requirements.) Half-course. *Weeks*

54. Corps Training. No course credit. *Staff*

Professional Officer Courses

All students selected to continue aerospace studies pursue the following courses:

First Year

101S. National Security in Contemporary American Society. An analysis of the current questions of the role and function of the professional military officer in a democratic society and the complex relationships in civil-military interactions. One course. *Knops*

102S. National Security in Contemporary American Society. This course deals specifically with the formulation and implementation of American defense policy. One course. *Knops*

104. Corps Training. No course credit. *Staff*

Second Year

201S. Aerospace Leadership and Management. An introduction to management fundamentals to include the knowledge base and process for managing. One course. *Griffin*

202S. Aerospace Leadership and Management. Application of management fundamentals to duties as junior officers/executives, to include principles of leadership and military law. One course. *Griffin*

203. The Problems of Flight and Aerospace Sciences of Weather and Navigation. Mandatory for pilot and navigator cadets, approval of instructor for all others. Half-course. *Knops*

204. Corps Training. No course credit. *Staff*

NAVAL SCIENCE

Professor Klause, Captain, U. S. Navy, *Chairman;* Visiting Associate Professor Marquis, Commander, U. S. Navy, *Director of Undergraduate Studies;* Visiting Assistant Professors Acree, Major, U. S. Marine Corps; Lipscomb, Lieutenant, U. S. Navy; Gravatt, Lieutenant, U. S. Navy; Blount, Lieutenant, U. S. Navy; Watkins, Lieutenant, U. S. Navy

Completion of all naval science courses listed is required for a commission. A maximum of 4 naval science courses may be offered as electives in satisfying degree requirements in Trinity College; only 2 naval science courses (junior or senior level) can be so offered in the School of Engineering. Fifteen hours of practical and applied leadership are required each semester.

11L. Naval Orientation. Military formations, movements, commands, courtesies, and honors; and elements of Unit leadership. *Lipscomb*

12. Naval Ships Systems. Structure, elements of design, stability, control compartmentation, communications, and propulsion systems as they bear on safe operation and combat or service effectiveness. One course. *Lipscomb*

51, 52. Seapower and Maritime Affairs Seminar. Strategic, tactical, and diplomatic aspects of seapower. *Gravatt*

125P. Naval Organization and Management. Naval lines of command and control; organization for logistics, service, and support; research on the practical application of fundamental management principles at lower echelons of Navy management structure. (Required preceptorial for NROTC students taking Management Sciences 125.) *Blount*

126. Concepts and Analyses of Naval Tactical Systems. Detection systems, offensive and defensive capabilities. One course. *Blount and Gravatt*

126L. Naval Ship Administration Laboratory. Management and organizational concepts in shipboard command and control. *Gravatt and Blount*

131. Navigation. Theory, principles, and procedures of ship navigation, movements, and employment. Dead reckoning, piloting, and electronic and celestial navigation. Naval Science 131L is a concurrent requirement. One course. *Watkins*

131L. Navigation Laboratory. Practical application of the theories and principles of navigation as presented in the lecture series. *Watkins*

132. Naval Operations. Components of general naval operations, including concepts and application of tactical formations and dispositions, relative motion, maneuvering board, and tactical plots, rules of the road, and naval communications. Naval Science 132L is a concurrent requirement. One course. *Watkins*

132L. Naval Operations Laboratory. Practical application of the theories of naval operations as presented in the lecture series. *Watkins*

141. Evolution of Warfare. A survey of the development of weaponry, tactics, and strategy affiliated with warfare, as exemplified by the confrontations selected for detailed study through World War II. One course. *Acree*

151. Amphibious Operations. An examination of the development of U. S. amphibious doctrine, with emphasis on current applications of that doctrine. One course. *Acree*

Romance Languages

Professor Tetel, *Chairman;* Assistant Professor Bryan, *Director of Undergraduate Studies in French;* Assistant Professor Landeira, *Director of Undergraduate Studies in Spanish;* Associate Professor Hull, *Supervisor of Language Instruction;* Professors Cordle, Davis, Fein, Fowlie, Niess, Predmore, and Wardropper; Associate Professors Garci-Gómez, Ripley, Stewart, and Vincent; Assistant Professors Barlow, Caserta, and Miller; Instructor Steegar

French 63, 74 and Spanish 63, 74 or equivalent are the prerequisites for all elective courses not taught in English. Students who, by reason of foreign residence, have had special opportunities in French or Spanish must be classified by the appropriate director of undergraduate studies.

The intensive language courses 181, 182 are recommended for students who wish to acquire proficiency in a second foreign language before entering graduate school.

FRENCH

Literature in English Translation

113. Society and the Novel in Modern France. Social structure and realities in fiction, beginning with the seventeenth century. One course. *Stewart*

116. The Nineteenth Century Novel. Stendhal, Balzac, Flaubert, and Zola. One course. *Niess*

151. Theory and Form of Tragedy. A study of major theorists and an analysis of principal Greek, French, and English tragedies. (Also listed as Comparative Literature 151.) One course. *Fowlie*

217. French Symbolism. (See listing below under French Literature.) *Fowlie*

223. Structuralism and the New Criticism. (See listing below under French Literature.) *Fowlie*

228. French Poetry of the Twentieth Century. (See listing below under French Literature.) *Fowlie*

233. Contemporary French Theatre. (See listing below under French Literature.) *Fowlie*

234. Proust. (See listing below under French Literature.) *Fowlie*

Language and Civilization

1-2. Elementary French. Understanding, speaking, reading, and writing French. Language laboratory available for recording-listening practice. Two courses. *Steegar and Staff*

63. Intermediate French. Grammar review; reading; oral practice, including laboratory experience. One course. *Hull and Staff*

74. Intermediate Readings in Modern French. Readings, discussion, composition, listening practice. One course. *Hull and Staff*

76. Introductory French Conversation. Practice in everyday conversational French. Prerequisite: French 63 or equivalent. Limited to fifteen students. One course. *Staff*

100. Active French. Intensive instruction in oral and written expression. Prerequisite: French 76 or equivalent. Limited to fifteen students. One course. *Bryan and Staff*

125. The French of Canada. The language of the French Canadians: its origins, history, and present status; psycholinguistic and sociolinguistic problems; bilingualism in Canada. Lectures and reports in English; readings in English and French. Prerequisite: French 74 or equivalent, or permission of instructor. One course. *Hull*

126. French Phonetics. Sounds, rhythm, intonation. Individual practice in language laboratory. Readings in phonetic theory. One course. *Hull and Steegar*

127S. Advanced Composition and Conversation. A systematic review of grammar; pronunciation and diction; oral and written reports. Prerequisite: French 100 or permission of instructor. One course. *Bryan*

129. French Civilization. Contemporary France as seen through its history, institutions, customs, and arts. Readings and discussion in French. One course. *Staff*

150T. Tutorial in Composition. Half-course. *Barlow or Staff*

181. Intensive French. An introduction to the language. Prerequisite: the second year of another foreign language or permission of instructor. One course. *Ripley*

182. Intensive French. Readings in modern literature: analysis and discussion. Prerequisite: French 181 or permission of instructor. One course. *Ripley*

209. Advanced Composition and Syntax. One course. *Hull*

210. The Structure of French. Modern French phonology, morphology, and syntax. Readings in current linguistic theory. One course. *Hull*

224. History of the French Language. The evolution of French from Latin to its present form; internal developments and external influences. One course. *Hull*

Literature

101, 102. Introduction to French Literature. An introduction to the major writers of the French literary tradition. Selections and complete works of poetry, fiction, theater, and essay. In the first semester: Middle Ages through the eighteenth century. In the second semester: nineteenth and twentieth centuries. Lectures and discussions; short essays and tests. Conducted in French. Two courses. *Fowlie and Staff*

103S, 104S. French Literature. Topics to be announced. Open only to freshmen and sophomores. Two courses. *Staff*

105. Explication de Textes. A study of the French method of textual analysis, with selections primarily from nineteenth and twentieth century authors. For students who have taken 101 and 102. One course. *Staff*

106S. Montaigne. A close reading of selected *Essais* aiming to integrate themes, structure, and style; frequent comparative allusions will be made to Proust, Pirandello, Malraux, and Sartre. One course. *Tetel*

107S. Perspectives in Criticism. Intensive readings leading to discovery of levels of meaning. Open only to freshmen and sophomores through the Advanced Placement Program, or by invitation of the department. One course. *Stewart*

108. Romanticism in French Literature. Lectures, readings, and class discussions of Romantic theory and of selected novelists (especially Constant, Stendhal, and Balzac), of representative poets, such as Lamartine, Vigny, Hugo, and Duman. One course. *Niess*

109. Toward Modernism in French Poetry. An introduction to modern trends in the nineteenth century; emergence from traditional romanticism; Art for Art's Sake and Parnassians (Gautier, Leconte de Lisle); the transition from decadence to symbolism (Baudelaire, Verlaine, Rimbaud, and Mallarmé). One course. *Barlow*

110. French Comedy in the Seventeenth and Eighteenth Centuries. The theatrical tradition of comedy and its evolution; readings from Corneille, Molière, Lesage, Marivaux, and Beaumarchais. One course. *Stewart*

111. French Drama of the Nineteenth Century. A survey of the French theatre from the Romantic period to the *Théâtre libre.* One course. *Staff*

112. French Drama of the Twentieth Century. A survey of literature for the stage from 1890 to the present. One play each of Claudel, Maeterlinck, Jarry, Giraudoux, Cocteau, Ghelderode, Anouilh, Montherlant, Sartre, Camus, Genet, Ionesco, Beckett, Pinget, Vian, Arrabal. One course. *Cordle or Staff*

114S. The Sixteenth Century. An introduction to the spirit of the French Renaissance as reflected in the literature of the age of Rabelais and Montaigne, Ronsard, and Du Bellay. One course. *Vincent and Tetel*

115. Realism and Naturalism in French Literature. Flaubert, Maupassant, and Zola. One course. *Niess*

117S. Masterpieces of French Medieval Literature. Lyric poetry, epic romance, and theater from beginning to the middle French period. One course. *Ripley*

119. French Drama of the Seventeenth Century. The plays of Corneille, Racine, and Molière are used to explore tragedy and comedy. One course. *Staff*

120. Seventeenth Century Poetry, Novel, and Rhetoric. Analysis of form and thought in selected works of La Fontaine, Mme. de La Fayette, Pascal, La Rochefoucauld, and La Bruyère. One course. *Staff*

121. The French Enlightenment. Religion, politics, and philosophic and literary ideas of eighteenth century France: Montesquieu, Voltaire, Rousseau, and others. One course. *Stewart*

122. The Early French Novel. The rise of the novel as a literary form up to the revolution. Readings from d'Urfé, Scarron, Mme de La Fayette, Furetière, Montesquieu, Prévost, Marivaux, Diderot, Rousseau, Laclos. One course. *Stewart*

132. French Poetry of the Twentieth Century. The symbolist heritage and surrealism. One course. *Barlow*

133, 134. Contemporary French Life and Thought. Major writers of the twentieth century and their historical and cultural circumstances. First semester: Claudel, Gide, Valéry, Proust, Apollinaire, Mauriac, Alain-Fournier, Cocteau. Second semester: Giono, Breton, Aragon, Malraux, Sartre, Beckett, Camus, Robbe-Grillet, Sarraute. Two courses. *Cordle*

141S, 142S. French Literature. Topic to be announced. Open to juniors and seniors. Two courses. *Staff*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors by permission of the department. Two courses.

193, 194. Independent Study. Directed reading and research. Open only to highly qualified seniors by permission of the department. Two courses.

213. French Literature of the Seventeenth Century. Its initial phase. Readings in the major literary works to the middle of the century. One course. *Staff*

214. French Literature of the Seventeenth Century. Its "classical" phase. Readings in the major literary works from the middle to the end of the century. One course. *Staff*

217. French Symbolism. Poetry and theories of Baudelaire, Mallarmé, and Rimbaud; Decadence; Lautréamont and Laforgue. One course. *Fowlie*

219. Old French Literature. An introduction to the reading of medieval French literary texts. One course. *Vincent*

220. French Pre-Romantic and Romantic Poetry. Chénier, Vigny, Lamartine, Musset, Hugo, and Nerval. One course. *Niess*

221, 222. The Nineteenth Century French Novel. First semester: Romanticism and Romantic Realism, studied especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. Two courses. *Niess*

223. Structuralism and the New Criticism. Backgrounds of the New Criticism and its contemporary practice: psychoanalysis (Jung, Freud); archetypes (Bodkin); existentialism (Sartre); myth and ritual (Frazer, Harrison, etc.); structuralism in anthropology (Lévi-Strauss); structuralism in literary criticism (Barthes, Starobinski, Rousset, etc.). To be conducted in English. Readings in English or French. One course. *Fowlie*

225. French Prose of the Sixteenth Century. Readings principally from Rabelais, Marguerite de Navarre and Montaigne. One course. *Tetel*

226. French Poetry of the Sixteenth Century. A critical appraisal of Villon, Marot, the Ecole Lyonnaise, the Pléiade, and the "Baroque Poets." One course. *Tetel*

228. French Poetry of the Twentieth Century. In the wake of symbolism: Valéry and Claudel; poetry as ritual: Péguy; Apollinaire and surrealist poetry; the contemporary movement: Michaux, Char, Saint-John Perse. One course. *Fowlie*

233. Contemporary French Theatre. A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. One course. *Fowlie*

234. Proust. A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. One course. *Fowlie*

241, 242. French Literature of the Eighteenth Century. First semester: the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. Two courses. *Stewart*

245, 246. French Literature of the Twentieth Century. First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman*. Two courses. *Cordle*

ITALIAN

Literature in English Translation

141, 142. Masterworks of Italian Literature. First semester: from the origins to the Baroque. Second semester: Ottocento and Novecento. Two courses. *Caserta*

284. Dante. (See listing below under Italian Literature.) *Fowlie*

Language and Civilization

1-2. Elementary Italian. Understanding, speaking, reading, and writing Italian. Language laboratory available for recording-listening practice. Two courses. *Caserta*

63. Intermediate Italian. Grammar review; reading; oral practice, including laboratory experience. One course. *Caserta and Staff*

74. Intermediate Readings in Modern Italian. Readings, discussion, composition, listening practice. One course. *Caserta and Staff*

100. Spoken Italian. Intensive instruction in contemporary Italian using selected topics and readings to build vocabulary and to provide practice in structural patterns. One course. *Caserta*

129. Modern Italy. Political, social, economic, and cultural problems in Italian history from 1861 to the present day. One course. *Caserta*

181. Intensive Italian. An introduction to the language. Prerequisite: the second year of another foreign language or permission of the instructor. One course. *Caserta*

Literature

182. Intensive Italian. Readings in modern literature: analysis and discussion. Prerequisite: Italian 181 or permission of instructor. One course. *Caserta*

183, 184. Readings in Italian Literature. Historical and critical analysis. First semester: Dante, Petrarch, Boccaccio, and the Humanists. Second semester: Foscolo, Manzoni, Leopardi, and Verga. Conducted in Italian. Two courses. *Caserta*

191, 192. Independent Study. Directed reading and research for juniors. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for seniors. Two courses. *Staff*

283. Italian Novel of the Novecento. Representative novelists from Svevo to the most recent writers. One course. *Caserta*

284. Dante. *La Vita Nuova* and a close reading of the *Inferno*. Conducted in English. Reading in Italian or English. One course. *Fowlie*

288. The Renaissance. Petrarch, Boccaccio, and Ariosto. One course. *Tetel*

PORTUGUESE

Language and Civilization

181. Brazilian Portuguese. An intensive introduction to the language. Prerequisite: second year of another foreign language or permission of the instructor. One course. *Miller*

185, 186. Conversation. Practice in spoken Brazilian Portuguese. Prerequisite: Portuguese 182 or permission of the instructor. Two courses. *Miller*

Literature

182. Contemporary Brazilian Theater. Authors studied include Jorge Andrade, Ariano Suassuna, and Dias Gomes. Prerequisite: Portuguese 181 or permission of the instructor. One course. *Miller*

183. Readings in Modern Brazilian Literature. Prerequisite: Portuguese 182 or permission of the instructor. One course. *Miller*

184. Literature of the Explorations: Asia, Africa, Latin America. Prerequisite: Portuguese 182 or permission of the instructor. One course. *Miller*

191, 192. Independent Study. Directed reading and research. Prerequisite: junior standing and permission of the instructor. Two courses. *Miller*

193, 194. Independent Study. Directed reading and research. Prerequisite: senior standing and permission of the instructor. Two courses. *Miller*

SPANISH

Literature in English Translation

152. Modern Mexico. (See listing below under Spanish Language and Civilization.) *Fein and TePaske*

157. Latin American Literature. Fictional and poetic works of the last thirty years that have made an impact on world literature. One course. *Fein*

Language and Civilization

1-2. Elementary Spanish. Understanding, speaking, reading, and writing Spanish. Language laboratory available for recording-listening practice. Two courses. *Miller and Staff*

63. Intermediate Spanish. Grammar review; reading; oral practice, including laboratory experience. One course. *Davis and Staff*

74. Intermediate Readings in Modern Spanish. Discussion, composition, listening practice. One course. *Davis and Staff*

76. Introductory Spanish Conversation. Practice in everyday conversational Spanish. Prerequisite: Spanish 63 or equivalent. Limited to fifteen students. One course. *Garci-Gómez and Staff*

100. Active Spanish. Intensive instruction in oral and written expression. Prerequisite: Spanish 76 or equivalent. Limited to fifteen students. One course. *Garci-Gómez and Staff*

150T. Tutorial in Composition and Syntax. Half-course. *Staff*

152. Modern Mexico. A problem oriented, interdisciplinary approach based on literature, history, the fine arts, and films. Readings in English or Spanish. (Also listed as History 152.) One course. *Fein and TePaske*

153S, 154S. Spanish Language. Topics to be announced. Two courses. *Staff*

164. Topics of Spanish Civilization. A humanistic study of Spain as a nation through its history, culture, people, and institutions. One course. *Landeira*

176S. Advanced Conversation. This course is designed to develop facility of expression through constant drill on vocabulary and conversational idiom. Prerequisite: Spanish 100 or permission of instructor. One course. *Landeira and Staff*

177. Advanced Composition and Syntax. Fundamental difficulties in the language; practice in writing idiomatic Spanish; exercises in translation from English to Spanish. For students who have a satisfactory command of Spanish grammar and fair conversational ability. Prerequisite: Spanish 176 or permission of instructor. One course. *Davis and Garci-Gómez*

181. Spanish. An intensive introduction to the language. Modern readings. Prerequisite: second year of another foreign language or permission of instructor. One course. *Miller*

182. Readings in Spanish American Literature. Prerequisite: Spanish 181 or permission of the instructor. One course. *Miller*

257. Old Spanish Language. The historical development of the language. Illustrative readings. One course. *Davis*

259. Spanish Phonetics. A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. Prerequisite: Spanish 176 or permission of instructor. One course. *Predmore*

Literature

101, 102. Introduction to Spanish Literature. An introduction to the major writers of the Spanish literary tradition. Selections and complete works of poetry, fiction, theater, and essay. First semester: Middle Ages through the eighteenth century. Second semester: nineteenth and twentieth centuries. Conducted in Spanish. Prerequisite: Spanish 74 or equivalent. Two courses. *Garci-Gómez and Landeira*

103S, 104S. Spanish Literature. Topics to be announced. Open only to freshmen and sophomores. Two courses. *Staff*

117S. Masterpieces of Spanish Medieval Literature. Selected works of the Medieval period. One course. *Garci-Gómez*

141S, 142S. Spanish Literature. Topics to be announced. Open to juniors and seniors. Two courses. *Staff*

155. Spanish American Short Fiction. Novelettes and short stories of the twentieth century. One course. *Fein*

156. The Spanish American Novel. Masterworks of the nineteenth and twentieth century. One course. *Fein*

161. Spanish Literature of the Renaissance and the Baroque. A study of selected works of the sixteenth and seventeenth centuries with attention to their reflection of social, religious, and political ideas. One course. *Miller and Wardropper*

162. Spanish Romanticism. A study of the romantic spirit in modern Spanish literature. One course. *Davis*

163. The Generation of 1898. Special emphasis on the novel and essay. The precursors: "Clarin" and Ganivet; Unamuno, Baroja, "Azorín," Valle-Inclán; influence on the next generations; Pérez de Ayala and Ortega y Gasset. One course. *Predmore and Landeira*

165S. Analysis of Great Spanish Authors. A close textual study of a few literary texts with some considerations of methods of literary criticism. The course is designed to give the student insight into various ways of interpreting and understanding literary works so that his experience of literature in general may be enriched. One course. *Wardropper*

166. Spanish Realism. The growth of realism in Spanish literature of the nineteenth century. One course. *Davis*

167. Golden Age Literature: Cervantes. Emphasis on *Quijote*. One course. *Predmore*

169. Literature of Contemporary Spain. Trends in the post-Civil War novel, theater, and poetry. One course. *Landeira*

170. The Picaresque Novel. One course. *Garci-Gómez*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified juniors by permission of the department. Two courses.

193, 194. Independent Study. Directed reading and research. Open only to highly qualified seniors by permission of the department. Two courses.

251. The Origins of Spanish Prose Fiction. A critical study based on close readings and discussion of selected examples of the principal genres of the romance and the novel: *Amadís de Gaula*, Diego de San Pedro's *La cárcel de amor*, the *Abencerraje*, the *Lazarillo*, Montemayor's *Diana*. One course. *Wardropper*

252S. Spanish Lyric Poetry Before 1700. A critical study based on close reading and discussion of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor*, la poesía de tipo tradictional, and Santillana; on Garcilaso, San Juan de la Cruz, Fray Luís de León, and Herrera; on Góngora and Quevedo. One course. *Wardropper*

253. The Origins of the Spanish Theater. A study of the evolution of the Spanish theater from the *Auto de los Reyes Magos* (twelfth century) to the end of

the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gómez Manrique, Encina, Gil Vicente, Torres, Naharro, Lope de Rueda, Juan de la Cueva. One course. *Wardropper*

255, 256. Modern and Contemporary Latin American Literature. First semester: poetry from *Modernismo* to the present. Second semester: twentieth century fiction. Two courses. *Fein*

258. Medieval Literature. An introduction to medieval Spanish texts. One course. *Davis and Garci-Gómez*

260. Origins and Development of Spanish Romanticism. Representative authors, including Espronceda, Rivas, Zorrilla, Bécquer, and Rosalía de Castro, with a stress on drama and poetry. One course. *Landeira*

261. Nineteenth Century Novel. A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazan, Blasco Ibañez, and their contemporaries. One course. *Davis*

262. Galdós. Works selected from the *Novelas contemporáneas*, the *Episodios nacionales*, and his drama. One course. *Davis*

265. Cervantes. The life and thought of Cervantes with special emphasis on his *Quijote*. One course. *Predmore and Wardropper*

266. Drama of the Golden Age. A study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. One course. *Wardropper*

275, 276. Contemporary Spanish Literature. First semester: the essay and lyric poetry. Revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester: tradition and innovation in the twentieth century Spanish novel with emphasis on the novels of Unamuno, Baroja, Valle Inclán, and Pérez de Ayala. Two courses. *Predmore*

ROMANCE LANGUAGES

Literature in English Translation

124. Continental Humanism. Readings from Boccaccio, Petrarch, Rabelais, Montaigne, Rojas, Cervantes, and Erasmus. One course. *Tetel*

160. An Approach to Comedy. Nature, purpose, and effect of comedy in the theater. Readings from the classics (Aristophanes, Plautus, Terence), the Renaissance (Machiavelli, Shakespeare, Molière, Lope de Vega), the Restoration, and the twentieth century. One course. *Wardropper*

Language

218. The Teaching of Romance Languages. Evaluation of objectives and methods; practical problems involved in teaching these languages on the elementary, secondary, and college level; analysis of textbooks, special foreign language programs, audiovisual aids, and tests. One course. *Hull*

DEPARTMENTAL MAJOR

Prerequisite. French or Spanish 74 or proficiency.

Major Requirements. Literature major: a total of 8 courses (above 76), no fewer than 5 literature courses, and no fewer than 2 language courses. The literature courses must represent at least three of the six historical periods (medieval, Renaissance, seventeenth, eighteenth, nineteenth, twentieth centuries for French; and medieval, Renaissance, seventeenth, eighteenth, nineteenth, twentieth, and Spanish American for Spanish).

Language Major. A total of 8 courses, no fewer than 4 language courses (for French, from 100, 126, 127, 129, 150T, 209, 210, 224; for Spanish, from 100, 150T, 153S, 154S, 176S, 177, 257, 259) and no fewer than 2 literature courses.

In order to give perspective to a student's program, majors in Romance languages will normally select, with the approval of the major adviser, appropriate courses from such fields as: (1) other languages and literature; (2) history; (3) philosophy; (4) appreciation courses in music and art; and (5) linguistics.

Russian

For courses in Russian, see *Slavic Languages and Literatures.*

Slavic Languages and Literatures

Associate Professor Krynski, *Chairman;* Associate Professor Jezierski, *Director of Undergraduate Studies and Supervisor of Language Instruction;* Assistant Professor Shonek; Lecturer Sagatov

1-2. Elementary Russian. Introduction to understanding, speaking, reading, and writing. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Two courses. *Staff*

63-64. Intermediate Russian. Intensive classroom and laboratory practice in spoken and written patterns. Reading in contemporary literature. Prerequisite: Russian 1-2, or two years of high school Russian. Two courses. *Staff*

101, 102. Russian Literature and Culture Through the Nineteenth Century. Prose, poetry, and drama with special attention to later periods. Readings in English (from *The Igor Tale* to Blok). Two courses. *Jezierski*

105. The Russian Theatre and Drama. Russian drama from its beginnings to the present. Readings in English or Russian. One course. *Jezierski*

119. Introduction to Russian Literature of the Nineteenth Century. Conducted in Russian. Prerequisite: Russian 63-64 or equivalent. One course. *Sagatov*

120. Introduction to Russian Literature of the Twentieth Century. Conducted in Russian. Prerequisite: Russian 119. One course. *Sagatov*

119P, 120P. Preceptorial. Elective preceptorials for students enrolled in Russian 119, 120. *Sagatov*

124. Masters of Russian Short Fiction. Includes Pushkin, Gogol, Tolstoy, Dostoevsky, Chekhov, and Babel. Readings in English. One course. *Jezierski*

179. Twentieth Century Russian Prose. Modern prose in the original. Textual analysis of Russian prose since the turn of the century. Prerequisite: Russian 1-2, 63-64, or permission of instructor. One course. *Krynski*

185. Vladimir Nabokov. The Russian and English novels, short fiction, plays, poetry, and criticism of Vladimir Nabokov. Readings in English. Qualified students may do some readings in Russian. One course. *Jezierski*

186. Non-Russian Slavic Literatures. Selected Polish, Czech, Serbian, Croatian, and Bulgarian authors, from the beginnings to recent times. Readings in English. (Also listed as Comparative Literature 186.) One course. *Jezierski*

188. Solzhenitsyn and the World of Soviet Concentration Camps. The major works of Alexander Solzhenitsyn with emphasis on concentration camp writings. Background readings by other authors and scholars, Russian and Western. One course. *Krynski*

191, 192. Independent Study. Directed reading and research. Open only to highly qualified students by permission of the department. Two courses. *Staff*

193, 194. Independent Study. Directed reading and research for qualified seniors. Prerequisite: permission of the department. Two courses. *Staff*

195. Advanced Russian. Review of grammar with an emphasis on the refinement of oral and written language skills. Prerequisite: Russian 120 or permission of instructor. One course. *Sagatov*

196. Readings in Modern Russian. An intensive reading-conversation course based on contemporary Russian literary and Soviet press texts, emphasizing problems in Russian-English and English-Russian translation. Prerequisite: Russian 195 or permission of the instructor. One course. *Sagatov*

201, 202. The Novelists of Nineteenth Century Russia. Development of the Russian novel against the European background, with emphasis on Dostoevsky and Tolstoy. Extensive readings in English or Russian. Two courses. *Krynski.*

205. The Structure of Polish in Relation to Russian. Comparative and contrastive study of the two major Slavic languages. Emphasis on preparing students to read Polish literary texts. One course. *Krynski*

206. Readings in Contemporary Polish Prose in the Original. Stylistic analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski and short stories by Slawomir Mrozek and Marek Hlasko. One course. *Krynski*

207. Soviet Literature and Culture. Literature since 1917. Readings in English from major works of prose, poetry, and drama. One course. *Jezierski*

207P. Preceptorial. Elective preceptorial for students enrolled in Slavic Languages and Literatures 207. *Jezierski*

212S. Pushkin. A survey of his life and works, with attention given to his role as a precursor of modern Russian literature. Readings in English or Russian. Prerequisite: Russian 101 or permission of instructor. One course. *Krynski*

213. The Slavs: Literature and Culture, 1918-1939. Study of the culture of the Soviet Union, Poland, and Czechoslovakia using representative literary masterpieces. Comparison with Western European trends. Readings in English. Prerequisite: permission of instructor. (Also listed as Comparative Literature 213.) One course. *Krynski*

213P. Preceptorial. Elective preceptorial for students enrolled in Slavic Languages and Literatures 213. *Krynski*

214. The Poles: Literature and Culture, 1940-1970. Study of the culture of Poland using representative literary masterpieces. The international context with emphasis on Western literary *avant-garde* and Soviet political influences. Special attention to Jewish themes. Readings in English. Prerequisite: permission of instructor. (Also listed as Comparative Literature 214.) One course. *Krynski*

214P. Preceptorial. Elective preceptorial for students enrolled in Slavic Languages and Literatures 214. *Krynski*

225S. Tolstoy. Life and works. Readings in English. One course. *Jezierski*

227. Gogol. Life and works; short stories, dramas, and the novel. Readings in English, but students knowing Russian will do part of the reading in that language. One course. *Jezierski*

230. Chekhov and the Russian Prose of the Turn of the Century. Structural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, Symbolist, and Decadent trends in Russian prose. One course. *Krynski*

230P. Preceptorial. Elective preceptorial for students enrolled in Slavic Languages and Literatures 230. *Krynski*

232. Dostoevsky. His major fiction. Readings in English. One course. *Jezierski*

DEPARTMENTAL MAJOR

Prerequisites. Russian 1-2 and 63-64, or equivalent.

Major Requirements. A minimum of 8 courses in the department. All majors must take the following 4 courses: Russian 91, 92, 195, 196, plus 4 courses in literature, 2 of which must be selected from 200-level courses.

Students contemplating graduate work may elect a more intensive program consisting of 10 courses. A knowledge in depth of Russian literature or some knowledge of Polish language and/or literature will facilitate admission to graduate school and subsequent study in the field.

Sociology

Professor Kerckhoff, *Chairman;* Assistant Professor House, *Director of Undergraduate Studies;* Professors Back, Maddox, McKinney, Myers, Palmore, Preiss, Roy, Smith, and Tiryakian; Associate Professors Simpson and Wilson; Assistant Professors Baldigo, Campbell, Evers, Hirschman, and Schneller; Instructor Rice

Understanding the nature and effects of social relationships, groups and organizations is essential to humane and rational action in our increasingly complex society and world. The Department of Sociology attempts to impart such understanding as one element of a liberal education. Undergraduate work in sociology, as in the other arts and sciences, does not prepare students for a specific vocation, but it is useful and adequate preparation for either employment or graduate study in any of the following areas: sociology and other social sciences, business, government and public service, and the professions of education, law, medicine, or social work.

The department and its offerings represent the diversity of topics and approaches in sociology, while also offering more concentrated work in certain areas, including deviant behavior (courses 120-123), population and ecology (141, 145, 243), family, sex roles, and socialization (149, 150, 152, 272 and 278), and others. In the major and in many courses, emphasis is placed on learning how to do sociology as well as on studying what others have done. Active involvement in the learning process is also fostered through seminar courses, independent study, honors work and internship, or fieldwork experiences. The Department both offers internship courses and encourages students to arrange individual internship experiences for which they receive independent study credit if the internship is coordinated with related academic study.

To provide a variety of educational experiences for the beginning student of sociology, the introductory course, Introduction to Sociology, has a variety of structures. In each, however, students learn basic approaches of sociology to social reality and some of the problems involved in observing, describing, and analyzing facets of social life.

91. Introduction to Sociology. Sections of limited enrollment (about 35-50). One course. *Staff*

91D. Introduction to Sociology. Two lectures and one discussion section (no more than 20 students per section). One course. *Staff*

91S. Introduction to Sociology. Taught as a seminar, enrollment limited to 20 per class. One course. *Staff*

101. Contemporary American Society. Social trends and social problems and their effects on individuals and society. Urbanization; bureaucracy; distribution of wealth, income and power; status of minorities. One course. *House*

Sociology 120-122 are designed as a sequence, and might optimally be taken in that order, with Sociology 120 being recommended preparation for 121, 122, and 123. However, there are no required prerequisites.

120. Perspectives on Deviant Social Behavior. Development and distribution of deviant social behavior, treating such topics as social disorganization, stress and strain, cultural and labeling theories in relation to crime and delinquency, drug addiction, homosexuality, suicide, or others. (Not open to students who have taken Sociology 143.) One course. *Preiss or Rice*

121. Law Enforcement and Judicial Systems. Treatment of deviant behavior by police, prosecutors, and courts. Problems of justice, efficiency, and ethics. Cross-cultural comparisons. One course. *Preiss or Rice*

122. Punishment and Treatment of Deviants. Concepts of punishment and rehabilitation. Programs and facilities for deviants. Structure and operation of "total" institutions, such as prisons and hospitals. Problems of returning to family and community life. One course. *Preiss or Rice*

123. Social Aspects of Mental Illness. Theoretical and practical sociological contributions to problems of etiology, definition, law and treatment; comparisons with other contributions; questions of public policy and programs. One course. *Back, House or Preiss*

132. Introduction to Sociological Research. Principles and procedures of sociological research. One course. *Evers or Rice*

136. Sociology of Modern Africa. An introduction to the modernization of sub-Saharan Africa. Primary emphasis given to the nature and formation of colonial society, as well as to the process of decolonization and its sources. One course. *Tiryakian*

139. Comparative Social Structure. Comparison of social phenomena in two or more societies. Sociological propositions, tested with American data and data from other societies. One course. *Hirschman or Wilson*

141. Population and Ecology. Relation of fertility, mortality, and migration to social development, population composition, and distribution. One course. *Evers or Myers*

142. The Sociology of Mass Communication. An analysis of the role of radio, the press, magazines, movies, and television in modern societies. An ex-

amination of the selective audiences, content characteristics, controlling elements, and organizational structure of the various media of mass communication. Comparative Canadian material considered where feasible. One course. *Smith*

144. Political Sociology. Politics as social behavior involving change in institutions and structures; current national and local issues. One course. *House or Preiss*

145. Urban Sociology. Historical, demographic, and ecological materials are used to study urban society with respect to its institutions, interaction patterns, differentiation, integration, disorganization, and decentralization. Comparative Canadian material considered where feasible. One course. *Myers or Smith*

146. Industry and Society. A study of the community and organizational life of industrial and white-collar workers in relation to the changing institutions of modern society. One course. *Roy*

147. The Black in the City. A comparative analysis of the situations and experiences of Black people in urban settings with attention to class, caste, ethnic, social, and racial factors. (Also listed as Black Studies 147.) One course. *Staff*

149. Sex Roles and Society. Nature and acquisition of sex roles. Cross cultural variations. Developing nature of sex roles in American society. One course. *Baldigo*

150. The American Family. The American family as an institutionalized group and its relationship with other institutions; the social psychology of family relations; variations by social class and ethnic group. One course. *Kerckhoff, Roy, or Simpson*

151. Sociology of Religion. The religious factor in modern society and the social factor in modern religion. Major sociological theories and marginal religious groupings. One course. *Tiryakian or Wilson*

152. Sociology of Education. Structure and operation of formal educational institutions in Western society and their effects on the social structure. Equality of opportunity, family-school, community-school, student-school relations, and peer influences in the school. One course. *Campbell, Kerckhoff or Roy*

154S. The Sociology of the Arts. An analysis of the social relations of the world of the arts (painting and sculpture, music, and literature) with emphasis upon creative artists, art publics, art organizations, and art works as they function in their social-cultural milieux. One course. *Back*

155. Sociology of Work. Study of the social organizations of work activities, of the human experiences and group relationships involved. Special focus on management-employee conflict and cooperation. One course. *Roy*

156. The Contemporary Woman: History and Prospects. (Also listed as Interdisciplinary Course 156.) Half-course. *Staff*

159. Black and White Relations in America. The history and changing nature of interaction between Blacks and Whites, including the sources and consequences of discrimination, integration, and Black power. One course. *Palmore*

160. Minorities and Work. A study of work and careers of minorities in relation to structures that limit their free movement in the labor force. One course. *Simpson*

172. Collective Behavior. Rumor and contagion as general processes; collective expression such as riots, protests, and behavior in disaster. Focus on contemporary Western society. One course. *Kerckhoff*

173. Social Movements. Social movements as agents of change. Structure and development of protest groups. One course. *Wilson*

182. Introduction to Sociological Theory. Images and theories developed to understand social behavior; a survey of current issues. One course. *Wilson*

184. Canada: Problems and Issues of an Advanced Industrial Society. (Also listed as Interdisciplinary Course 184.) *Preston and Visiting Lecturers.*

185, 186. Junior Tutorial. Prerequisite: Sociology 91 (or 91D or 91S) or permission of the Director of Undergraduate Studies. Half-course each semester. *Staff*

193, 194. Independent Study. Prerequisite: permission of the instructor. Two courses. *Staff*

195S, 196S, 197S, 198S. Senior Seminar in Special Topics. Four courses. *Staff*

225. Medical Sociology. Current issues in the organization, development, and the utilization of resources for health care. One course. *Back or Maddox*

241. Social Stratification. The nature of hierarchical and vertical differentiation for the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. One course. *Campbell, Evers or Roy*

242. The Sociology of Occupations and Professions. The social significance of work. Analysis of forces changing the contemporary occupational structure, typical career patterns of professions and occupations, and the social organization of occupational groups. One course. *Roy or Simpson*

243. Population Dynamics and Social Change. Social scientific aspects of the determinants and consequences of population trends. One course. *Evers or Myers*

251. The Sociology of Modernization. Theories and perspectives on the nature of modernization and modernity in Western and non-Western countries. One course. *Hirschman or Tiryakian*

255. Race and Culture. A comparative study of race relations in world perspective developed around such themes as race and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. One course. *Hirschman*

259. Religion and Social Change. The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). Prerequisite: either Anthropology 264, Sociology 151, or the equivalent. One course. *Tiryakian or Wilson*

260. Science, Technology, and Society. Science as a social phenomenon. Relations of science to technology and their articulation through public policy. Interaction of the institutions of science with other societal institutions. One course. *McKinney*

272. The Socialization Process. Mechanisms and variations in socialization by position in the social structure (class, caste, urban-rural); contributions made by various socialization agencies (family, school, peer groups, mass media) in Western society. One course. *Kerckhoff*

275. Social Attitudes and Individual Behavior. Such issues as the following are considered: the importance of symbolic interaction, the development of the "Self," the social structuring of the socialization process, individual movement within the social structure, and the importance of membership groups and reference groups. One course. *Back or House*

278S. Social Structure and the Life Cycle. A study of the relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. One course. *Maddox*

295. Methodology in Sociology. Considerations of the nature of scientific method, as well as alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation both on the general level of research design and the specific level of special techniques. The process and logic of data analysis. Relations of theory and research are stressed. One course. *Smith*

297. Introductory Statistical Analysis. Basic descriptive statistics, regression and correlation, t-tests and the analysis of variance, chi square techniques, and other topics. Stress on practical applications. Extensive exercises in statistical computing using SPSS and other programs. One course. *Campbell*

298S, 299S. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. Two courses. *Staff*

DEPARTMENTAL MAJOR

Prerequisite. Sociology 91.

Major Requirements. Seven courses in the department above 91, including Sociology 132 and either one 200-level course or one senior seminar.

A sociology major normally takes at least 4 related courses in the following departments: Anthropology, Economics, Education, History, Mathematics, Political Science, or Psychology.

Honors work. Qualified majors are encouraged to undertake honors work leading to graduation with distinction. Any major with a *B+* average in sociology and a B average in all courses is eligible, though the Director of Undergraduate Studies may waive this requirement in special cases. To receive departmental honors a major must complete a paper involving significant independent research or scholarship and pass an oral examination on the paper conducted by a three-person committee, at least two of whom, including the chairman, must be members of the Department. Normally, students will prepare the paper over the course of the senior year, working in close collaboration with their chairman and committee, and receiving on the average two course credits in independent study for the work.

Statistics

Statistics courses offered in several departments at Duke are classified according to function (Tracks) and level as follows: Track 1 includes statistical inference courses for nonstatisticians; Track 2, statistical inference courses for statisticians; Track 3, stochastic processes courses and Track 4, stochastic communications theory courses. Within each track, courses are classified by level

according to the amount of prerequisite statistical knowledge needed. First-level Track 1 courses, which are basic statistics courses for nonstatisticians, cover a certain core curriculum and have no formal statistical prerequisites. For further information on the statistics courses see *Statistics at Duke*, which is available on request from the Department of Mathematics.

Zoology

Professor Fluke, *Chairman;* Associate Professor Ward, *Director of Undergraduate Studies;* Professors Bailey, Bookhout, Costlow, Gillham, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, Tucker, and K. Wilbur; Associate Professors Barber, Vogel, and Wainwright; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Bergeron, Forward, Lundberg, McClay, Storey, Sutherland, and H. Wilbur; Instructors Colacino and Wise

See *Biology* for listing of introductory courses.

The L suffix on a zoology course number indicates that the course includes a laboratory.

In addition to those courses bearing the S suffix, the following zoology courses also fulfill the seminar-type learning experience: 103L, 120L, 173L, 180L, 204L, 216L, 218L, 224L, 238L, 245L, 258L, 262L.

95S, 96S. Undergraduate Seminars. One course maximum except with permission of the Director of Undergraduate Studies. *Staff*

103L. Principles of Ecology. Physical, chemical, and biological processes that determine the distribution and abundance of animals, emphasizing population dynamics, species interaction, biogeography, nutrient cycling, and energy flow through food webs. Prerequisites: college biology and Mathematics 31. Lectures, field and laboratory exercises, and student talks. One course. *H. Wilbur and Livingstone*

108L. Developmental and Comparative Anatomy of Vertebrates. Lectures and laboratory on the embryology, anatomy, and evolution of vertebrate organ systems. Not open to students who have had the courses previously numbered Zoology 53 or 56. Prerequisite: college biology. One course. *Lundberg*

114L. Introduction to Biological Oceanography. Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: college biology. (Given at Beaufort.) One and one-half courses. *Staff*

117. Heredity and Society. An introduction to genetics with emphasis on the effects of environment and heredity upon the individual and the population. A student may not receive credit for both Zoology 117 and 180 or Nursing 105. Prerequisite: college biology or permission of instructor. One course. *Ward*

120L. Ornithology. Lectures, laboratory, and field trips dealing with the classification, adaptations, and natural history of birds. Prerequisite: college biology; Zoology 108 is recommended. One course. *Bailey*

135. Evolutionary Systematics. Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186, and Zoology 286. Prerequisite: college biology. (Also listed as Botany 135 and Zoology 235.) One course. *Bailey, Lundberg, or Stone (Botany)*

135L. Evolutionary Systematics. Same as 135 with laboratory included. Open to majors and non-majors. One course. *Bailey, Lundberg, or Stone (Botany)*

150L. Physiology of Marine Animals. Comparative physiology including ecological and behavioral adaptations. Lectures and laboratories. A student may not receive credit for both Zoology 150L and 250L. Prerequisites: college biology and chemistry and permission of instructor and director of undergraduate studies of the student's major department. (Given at Beaufort.) One course. *Forward*

151L. Principles of Physiology. An introductory survey. Prerequisites: college biology and a year of college chemistry. One course. *Tucker*

160. Principles of Cell Biology. Structure and function of organelles, metabolism, and regulatory mechanisms. Prerequisites: college biology and chemistry. One course. *McClay*

160L. Principles of Cell Biology. Same as 160 with laboratory included. One course. *McClay*

169L. The Marine Environment. For description see Marine Sciences.

173L. Tutorial in Animal Diversity. Comparative functional morphology of animals of major phyla. Lectures, laboratories, and tutorials (essays and oral reports). Not open to students who have had Zoology 174, 175, or 275. Prerequisite: permission of instructor. One course. *Wainwright*

174L. Animal Diversity. Same as 173L except lectures and laboratories only. Not open to students who have had Zoology 173, 175, or 275. Prerequisite: college biology. One course. *Wainwright*

175L. Invertebrate Zoology. Lectures, readings, and laboratory dealing with free-living and parasitic invertebrates. Field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174, or 274. Prerequisite: college biology. (Also listed as Zoology 275L.) One course. *Bookhout*

180. Principles of Genetics. Structure and properties of genes and chromosomes, and evolution of genetic systems. (Also listed as Botany 180, Botany 280, and Zoology 280.) Prerequisites: introductory courses in biology, chemistry, and mathematics, or equivalent. One course. *Boynton (Botany), Gillham, and Others of the University Program in Genetics*

180L. Principles of Genetics. Same as 180 with laboratory included. One course. *Boynton (Botany), Gillham, and Others of the University Program in Genetics*

186. Evolutionary Mechanisms. Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135, Botany 235, Zoology 135, and Zoology 235. Prerequisite: college biology. (Also listed as Botany 186, Botany 286, Zoology 286, and under the University Program in Genetics.) One course. *Antonovics (Botany) and H. Wilbur*

191T, 192T. Independent Study. For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses maximum. *Staff*

195S, 196S. Undergraduate Seminars. Two courses maximum except with permission of the Director of Undergraduate Studies. *Staff*

197, 198. Undergraduate Colloquium. Does not satisfy major or distributional requirements. One course maximum except with permission of the Director of Undergraduate Studies. *Staff*

201. Animal Behavior. Emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics, and evolution, or permission of the instructor. One course. *Klopfer or Rosenson (Visiting Summer Faculty*

202L. Introduction to Comparative Behavior. Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Lecture and laboratory. Prerequisite: one course in physiology. (Given at Beaufort.) One and one-half courses. *Salmon*

203L. Marine Ecology. Class discussion on selected papers and field projects; practice in scientific writing and use of computers in ecology. Prerequisites: a course in general zoology, invertebrate zoology, or an appropriate equivalent, and a year of mathematics; some knowledge of statistics will be helpful. (Given at Beaufort.) One and one-half courses. *Sutherland*

204L. Population and Community Ecology. Theoretical ecology emphasizing the evolution of life cycles, mathematical properties of systems of interacting species, and mechanisms of species interactions. Laboratories emphasize biometrical and experimental testing of ecological theory in relation to a variety of habitats. Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus, senior or graduate standing, or permission of instructor. One course. *H. Wilbur*

205. Elements of Theoretical Biology. An introduction to elementary mathematical biology, conceived as the study of axiomatized mathematical theories and their biological models. Prerequisites: college biology and mathematics, or permission of instructor. One course. *Gregg*

214L. Biological Oceanography. Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Shipboard investigations of biological productivity of the continental shelf ecosystem. Prerequisite: permission of instructor. (Given at Beaufort.) One and one-half courses. *Barber*

216L. Limnology. Lakes, ponds, and streams; their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities living in them. Lectures, field trips, and laboratory work. Usually offered in alternate years. Prerequisites: college biology, chemistry, physics, and Mathematics 31, or permission of instructor. One course. *Livingstone*

218L. Paleobiology. Pleistocene ecology, climatology, and ecological geography; laboratory study of lake beds with emphasis on pollen grains. Prerequisites: permission of the instructor and a course in ecology. One course. *Livingstone*

224L. Vertebrate Zoology. Life histories, adaptations, ecology, and classification of vertebrate animals. Lectures and laboratories. Prerequisite: Zoology 108. One course. *Bailey*

229. Morphogenetic Systems. Lectures on the interplay of theory and experiment in twentieth century developmental biology. Prerequisite: college biology. One course. *Gregg*

235. Evolutionary Systematics. Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186, Zoology 286. Prerequisite: college biology. (Also listed as Botany 135, Botany 235, and Zoology 135.) One course. *Bailey, Lundberg, or Stone (Botany)*

235L. Evolutionary Systematics. Same as 235 with laboratory included. Open to majors and non-majors. One course. *Bailey, Lundberg, or Stone (Botany)*

238L. Systematic Zoology. Theory and practice of collection, identification, and classification of animals. Lectures and laboratories. Prerequisite: college biology. One course. *Bailey*

239S. Biogeography. Old and new distributional concepts of animals and plants involving physical geography, geology, paleontology, systematics, evolution, population dynamics, and dispersal. Prerequisite: permission of instructor. One course. *Bailey*

245. Radiation Biology. Actions of ionizing and excitational radiations on life processes; biological use of radioactive tracers; nucleonics. Prerequisites: college physics, mathematics, and chemistry. One course. *Fluke*

245L. Radiation Biology. Same course as 245 with laboratory included. One course. *Fluke*

246. Physical Biology. Topics involving the physical basis of living organisms and systems, such as physical optics and biomechanics, and application to functions at higher levels of organization. Prerequisites: college mathematics, chemistry, physics, and one biology course beyond the introductory level, or permission of the instructors. One course. *Fluke and Wainwright*

248. Introductory Biochemistry. The chemistry of proteins, lipids, carbohydrates, nucleic acids, and the metabolic interrelationships of these compounds. The biochemical basis of photosynthesis, genetics, vision, nutrition, nerve conduction, and muscle contraction will also be considered. Prerequisites: organic chemistry (second semester may be concurrent) and college physics and mathematics, or permission of instructor. (Also listed as Biochemistry 248 and Botany 248.) *Siegel (Biochemistry)*

250L. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) One and one-half courses. *Forward*

252. Comparative Physiology. The physiological mechanisms of animals studied on a comparative basis. Prerequisite: Zoology 151 or equivalent. One course. *Schmidt-Nielsen*

254S. Fluid Flow and Living Systems. Physical principles of low speed flow; applications to locomotion, circulation, dispersal, ventilation, filtration, and heat dissipation. Prerequisites: college physics and Mathematics 31 or equivalent. One course. *Vogel*

258L. Laboratory Research Methods. Radioisotope methods, spectrophotometry, light microscopy, transmission and scanning electron microscopy, X-ray diffraction, gel electrophoresis, isolation of cell components, and other methods. Students may select methods according to their interests and research

needs. Prerequisite: permission of instructor. Credits to be arranged. *K. Wilbur and Staff*

260. Advanced Cell Biology. Structural and functional organization of cells and their components, emphasizing current research problems and prospects. Prerequisites: introductory cell biology or genetics and permission of instructor. One course. *Nicklas, K. Wilbur, and Staff*

262L. Cytological Materials and Methods. General cytological analysis, with emphasis on chromosome studies using current optical, cytochemical, and experimental techniques. Prerequisite: Zoology 160 or 260 or equivalent (may be taken concurrently). One course. *Nicklas*

265S, 266S. Seminar in Chromosome Biology. Current research on chromosome structure and function, mitosis, and meiosis. Prerequisites: a course in cell biology or genetics and permission of instructor. Two half-courses. *Moses (Anatomy) and Nicklas*

274L. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under normal and experimental conditions. Field trips included. Not open to students who have had Zoology 275. Prerequisite: college biology. (Given at Beaufort.) One and one-half courses. *Staff*

275L. Invertebrate Zoology. Lectures, readings, and laboratory work dealing with free-living and parasitic invertebrates. Field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174, or 274. Prerequisite: college biology. (Also listed as Zoology 175L.) One course. *Bookhout*

277L. Endocrinology of Marine Animals. Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals, primarily invertebrates. Prerequisite: one course in physiology. (Given at Beaufort.) One and one-half courses. *Hagadorn (Visiting Summer Faculty)*

278L. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: permission of instructor. (Given at Beaufort.) One and one-half courses. *Bookhout*

280. Principles of Genetics. Structure and properties of genes and chromosomes and evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics, or equivalent. (Also listed as Botany 180, Botany 280, and Zoology 180.) One course. *Boynton (Botany), Gillham, and Others of the University Program in Genetics*

286. Evolutionary Mechanisms. Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135, Botany 235, Zoology 135, Zoology 235. Prerequisite: college biology. (Also listed as Botany 186, Botany 286, Zoology 186, and under the University Program in Genetics.) One course. *Antonovics (Botany) and H. Wilbur*

288S. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and permission of instructor. (Also listed as Anatomy 288.) Half-course. *Counce (Anatomy)*

295S, 296S. Seminar. Topics, instructors, and course credits announced each semester. *Staff*

Genetics, The University Program. Genetics courses offered by the Department of Zoology are part of The University Program in Genetics described in this *Bulletin*.

Marine Laboratory. Consult Marine Sciences in this *Bulletin* for offerings at the Duke University Marine Laboratory and for details of the spring semester program for undergraduates at Beaufort.

DEPARTMENTAL MAJOR

Prerequisites. Biology 11-12 or Biology 14 or consent of the Director of Undergraduate Studies.

Major Requirements. A minimum of 8 courses, not including the above prerequisites. Of the 8 courses, at least 4 must be Zoology courses other than independent study and seminars, 2 of which must have related laboratory experience. Three of the remaining 4 courses ordinarily consist of courses in chemistry beyond organic chemistry or courses in other related departments at the 100 level or above. Acceptance of such courses for inclusion in the basic 8 requires prior permission of the Director of Undergraduate Studies with the exception of Chemistry 161 and any mathematics course at the 100 level or above. No one course may be used to satisfy the requirements for zoology and another major, or for a zoology major and a distributional requirement.

Areas of Concentration. Molecular and cellular biology (cell physiology, cytology, genetics, development); organismic biology (comparative physiology, comparative and functional morphology, embryology); population biology (population genetics, speciation, systematics, biogeography); animal behavior; ecology (including biological oceanography and limnology).

Departmental Handbook for Majors. Any student who is interested should obtain a copy of the *Handbook for Zoology Majors* from the office of the Director of Undergraduate Studies. The *Handbook* suggests appropriate combinations of courses for the above listed areas of study, describes the advising system and special programs, and gives the interests and background of the faculty.

A.B. and B.S. Degrees. No distinction is made between the A.B. and B.S. degrees; a student may elect to receive either degree at the time he declares his major.

School of Nursing

Professor Wilson, *Dean;* Associate Professor Most, *Director of Academic Programs;* Professors Fortune, Gratz, Minniear, Stone, and Whitner; Associate Professors Hall, Horton, Norville, and Schenk; Assistant Professors Anderson, Bourbous, Brundage, Bullock, Davenport, De Napoli, Dery, Dietz, Gelein, Hogue, Kirkpatrick, Lamper, Long, Lynds, Persing, Smith, and Turner; Instructors Askins, Craig, Hewitt, Humphrey, Kaufman, Messick, Morgan, Stefanics, Woods, and Yoder; Lecturers Dorsey, Harris, Mandetta, and Reckless; Clinical Faculty Barton, French, Gaines, Hill, O'Toole, and Rosser

97, 98. Human Ecology I and II. An interdisciplinary course in the natural sciences covering the impact of a changing physical and biological environment upon man. Prerequisites: two courses in natural science. Two courses. *Gratz*

99. Introduction to Statistics in the Health Field. Statistical concepts involved in the compilation, presentation and analysis of health data. Measures and methods to describe, correlate and make inferences about frequency distri-

butions. Open to non-nursing majors. Priority will be given to sophomores nursing students. One course. *Dorsey*

101-102. Theoretic and Scientific Bases of Nursing Practice. Builds upon courses in human ecology to explore major theories of man's normal adaptive responses throughout the life cycle. Concepts relating to the nurse-patient relationship, man's self system and man in the context of his supersystems of family, community, and society are explored. A systems theory framework is used to consider major assaults to man's integrity and responses to threats to health. Prerequisites: Nursing 97 and 98 or equivalent. Two courses. *Staff*

103-104. Development of Nursing Skills and Attitudes. Correlated with Nursing 101-102 by selection of clients of a variety of ages as exemplars of man's normal adaptation and his response to assaults. Students will be giving nursing care to individuals in a variety of settings. Application of theory and concepts from Nursing 101 and 102 are facilitated in a weekly seminar of clinical groups. Nursing practice encompasses the development of psychomotor skills, cognitive skills, and attitudes essential to the process of nursing. Prerequisites: Nursing 97 and 98 or equivalent. Four courses. *Staff*

105. Human Genetics and Societal Problems. A course in the current state of research on birth defects, biochemical disorders, the human chromosome complement, and malformations resulting from mishaps in the chromosomes. Open to non-nursing majors. Pass/fail option. Fall only. One course. *Gratz*

121S. Parenthood. An investigation of parenting behavior with a focus on the meaning of experiences to the mother and father and the means by which individuals can maximize the positive potential of these experiences. Open to sophomores or above and non-nursing majors. Pass/fail option. One course. *Harris*

125. Theory and Practice of Communication. Students interview selected individuals for the purpose of practicing effective communication skills and methods of interviewing. When possible the student develops an ongoing short term relationship to facilitate the individual's problem solving process. Group conferences are utilized for faculty and peer supervision to maximize student learning to evaluate effectiveness of interactions. Classes utilize lectures, audiovisual demonstrations, gaming and simulation, and student-led discussions. Open to non-nursing majors. Not open to upper division nursing students. Prerequisite: permission of instructor. Pass/fail option. One course. *Bourbous or Craig*

144. An Introduction to Gerontology. A study of the process of aging as it relates to the elderly with focus on physiological, sociopsychological changes and economic status. Emphasis will be on selected areas such as theories of aging, demographic changes and social policy. Open to sophomore through senior students including non-nursing majors. Pass/fail option. Spring only. One course. *Stone*

151. Functional Aspects of Nursing Practice. Theories, practices, and constraints influencing functional roles in nursing practice, e.g., economics and systems of health care, organization, and administration of agencies and institutions delivering health care, legal protection, and constraints of the practitioner. Prerequisites: Nursing 102 and 104. One course. *Dietz and Schenk*

153, 154. Distributive and Episodic Nursing Practice. Continuation of Nursing 101-102, and Nursing 103-104 into the senior year. Each student will have learning experiences with patients in each of the major clinical areas:

medical-surgical, psychiatric, maternal and child health, and community health nursing. In distributive nursing practice, a systems perspective is the approach for acquiring the conceptual, interpersonal, and technical skills for the promotion, maintenance, and restoration of health and prevention of illness for designated populations. The concept of distributive nursing practices has been broadly conceived to encompass the study of multiple components of care. Some of these components may be defined in the context of community nursing practice but they also encompass both primary care and long-term care in community facilities and other types of ambulatory health service settings. The focus of episodic nursing practice is the direct care of hospitalized patients with complex, acute or chronic, mental, and physical illness wherein rapid and/or crucial nursing decisions are required and collaboration with other health disciplines is essential. Prerequisites: Nursing 102 and 104. Four courses. *Staff*

161. Applied Human Physiology. An in-depth study of selected physiological processes significant to the health needs of man. Emphasis is upon those aspects of physiology that are reflected in patient care problems requiring effective nursing intervention. Prerequisite: N98 or equivalent. Pall/fail option. Fall only. One course. *Gratz*

162. Ecological Concepts and Their Application to Environmental Health. An in-depth study of current environmental problems significant to the health needs of man. Emphasis is on those ecological concepts that are reflected in patient health problems. Open to non-nursing majors. Pass/fail option. Spring only. One course. Not offered 1975-76. *Gratz*

163S. Suicidology and Crisis Intervention. Exploration of theories related to destructive behavior and methods for intervening and managing individuals and families before, during, or following such periods. Clinical practice will be provided for applying theories and techniques. Open to non-nursing majors with the permission of the instructor. Pass/fail option. One course. *Stefanics*

167S. Poverty and Health. A study of poverty designed to develop an awareness of the relationship between poverty and health. Seminars, films, and actual experience with poverty groups will be used to acquaint the student with a diversity of perceptions and observations germane to an understanding of health problems among the poor. Open to sophomores and above including non-nursing majors with the permission of the instructor. Pass/fail option. One course. *Humphrey and Long*

169. Human Sexuality. A study of the intrapersonal, interpersonal, and sexual aspects of an individual's existence and the forces shaping prevailing and future sexual expressions and human sexuality. Open to non-nursing majors. Pass/fail option. One course. *Mandetta, Reckless, and Woods*

172. Psychosomatic Illness and Group Process. A study of patients with psychosomatic and somatopsychic illness with opportunities to explore causal factors together with approaches for alleviation. Nursing and medical students assume responsibility for direct patient care under supervision and have the opportunity to attend group therapy sessions. Prerequisite: permission of instructor. Pass/fail option. One course. *Reckless*

178S. Advanced Concepts of Nursing for Patients with Cardiovascular Disease. Examination and clinical exploration of the role of the nurse in providing health care to individuals with cardiovascular disease. Open to senior nursing students. Pass/fail option. One course. *Dery, Gelein, and Kirkpatrick*

179. Nursing in Nephrology. Planned experience providing nursing care for

patients with clinical disturbances of renal function utilizing current treatment modalities in a variety of treatment settings. Open to second semester juniors and seniors in the nursing major. Pass/fail option. One course. *Brundage*

183. Introduction to Methods of Research in Nursing. Study of research in nursing and the implications for nursing practice. Prerequisites: basic statistics and Nursing 103 or permission of instructor. Pass/fail option. One course. *Most and Whitner*

186S. Thanatology. An in-depth exploration of man's relationship to death with its associated medical and behavioral phenomena. Clinical experience supplements class discussion of those factors influencing individuals and their families in the process of relating to death. Open to juniors and above including non-nursing majors. Prerequisite: permission of instructor. Pass/fail option. One course. *Gelein*

187. Patient Evaluation. A study of the historical development of disease process through methods and techniques of eliciting health history and physical examination. The relationship of historical and physical data is demonstrated by repeated experience with in-hospital patients. Open to seniors and second semester juniors. Permission of the instructor through submission of self-objectives for course. Pass/fail option. One course. *Wilson*

188. Oncological Nursing. An in-depth study of nursing the patient with cancer focusing on prevention, detection, diagnosis, treatment, and rehabilitation. Open to second semester junior and senior nursing students. Pass/fail option. One course. *Norville*

189. Psychiatric Nursing. Focuses on dynamic psychiatric nursing and provides opportunities for the student to increase depth of knowledge of and skill in applying concepts of psychiatric nursing intervention in selected settings. Open to seniors in the nursing major. Pass/fail option. One course. *Bullock*

191, 192, 193, or 194. Independent Study. Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum of one course. Pass/fail option. *Staff*

197, 198. Undergraduate Thesis. Systematic study of a nursing problem. The study culminates in a written thesis. The method of study may involve research or may be limited to the student's critical review of others' work which bears upon the problem selected for study. Prerequisites: completion of the junior year with at least a *B* + average in all nursing courses, including electives in nursing, and permission of the course coordinator. Two courses. *Hogue*

MAJOR IN NURSING

The major requirements are included in the minimum total of 32 courses listed under Lower and Upper Division Requirements on page 25. The specific courses in the upper division satisfying the nursing major that must be included are: Nursing 101, 102, 103, 104, 151, 153, 154, and 191, 192, 193, or 194.

School of Engineering

ENGINEERING (INTERDEPARTMENTAL)

5, 6. Engineering Experiences. In order to provide opportunities for engineering freshmen to become involved in engineering activity and to assist

them in determining areas of interest, a number of engineering faculty members have developed miniprojects approved by the department of the faculty member. A list and brief description of each project with enrollment limitations are printed each semester. Pass/fail. Two quarter-courses. *Staff*

11. Engineering Graphics. Graphical theory and techniques for engineering design and communication. Visualization and conventional representation of points, lines, surfaces, and objects using freehand sketches. Orthographic (including sectional and auxiliary), perspective, isometric, and oblique views. Introduction to working drawings. Elements of descriptive geometry, and graphic mathematics. Not open to seniors. Half-course. *Arges*

31. Computers in Engineering. Introduction to use of digital computers in engineering. Attributes of digital computer systems; program languages, flow charts; numerical analysis, including approximation and interpolation, searches and maximization, linear equations; applications to engineering; introduction to decision processes in engineering, including linear programming, optimization network methods; punched card operation; graphical output. Not open to students who have completed Computer Science 51 or M.E. 31. One course. *Garg, Utku, and Warner*

72. Introduction to Systems Dynamics. Unified treatment of mechanical, electrical, fluid, and thermal dynamic systems. Formulation and solution of differential equations; operators, transfer functions, and complex variables. Energy concepts for multiport system analysis. Simulation and analog solution of a variety of engineering problems. Prerequisites: Physics 51 and Math. 32. One course. *Wright, Garg, or Macduff*

75. Mechanics of Solids. Analysis of force systems and their equilibrium as applied to engineering systems. Stresses and strains in deformable bodies; mechanical behavior of materials; applications of principles to static problems of beams, torsion members, and columns. Selected laboratory work. Not open to students who have completed C.E. 23 (see C.E. 73). Prerequisites: Physics 51 and Math. 32. One course. *Arges, Palmer, and J. F. Wilson*

83. Structure and Properties of Solids. An introduction to materials science and engineering, emphasizing the relationships between the structure of a solid and its properties. The atomic and molecular origins of electrical, mechanical and chemical behavior are treated in some detail for metals, alloys, polymers, ceramics, glasses, and composite materials. Prerequisites: Chemistry 11 and Math. 31. One course. *Shepard, Cocks, and Pearsall*

104. Thermodynamics and Heat Transfer. Development of the laws of thermodynamics emphasizing the logical structure and manipulation. Thermodynamic property relations for simple substances and mixtures. Solutions of energy problems which concentrate on methods of analysis. Introduction to conduction, convection, and radiation modes of heat transfer. Prerequisites: Physics 52 and Math. 103. One course. *Chaddock or Elsevier*

113. Current Topics in Materials Science. Extension of the principles of Engineering 83 to areas of current interest, including biomaterials, fuel cells, composite materials, materials problems in energy conversion systems, computer systems, stress corrosion cracking, and other topics. Prerequisite: Engineering 83. One course. *Cocks, Pearsall, and Shepard*

122. Transport Phenomena. A unified treatment of momentum, energy, and mass transport from the continuum viewpoint. Parallel developments of the basic relationships, design equations, and engineering applications illustrate

problem solving and the usefulness of analogy between the three transport mechanisms. Selected laboratory work. Prerequisites: Physics 52 and Math. 103. One course. *Chaddock or Harman*

123. Dynamics. An introduction to the principles of particle and rigid body dynamics with engineering applications. Vector analysis used to describe the kinematics of motion in space and in a plane; the inertia tensor. Concepts of impulse-momentum and work-energy. An introduction to vibrations, wave motion, and Lagrange's equation. Prerequisites: Math. 103 and Physics 51. One course. *Dvorak and J. F. Wilson*

135. Continuum Mechanics. The concept of continua. Vectors. Cartesian Tensors. Equilibrium; stress, deformation, and velocity fields; compatibility. Isotropy. Constitutive equations. Virtual work principle. Mechanical properties of solids and fluids. Simple problems in elasticity, viscoelasticity, and plasticity. Prerequisites: Physics 51, Math. 104 or 111. One course. *Dvorak*

145. Fluid Mechanics. Physical properties of fluids; fluid-flow concepts and basic equations; continuity, energy and momentum principles; dimensional analysis and dynamic similitude; viscous effects; applications emphasizing real fluids. Selected laboratory work. Corequisite: Engineering 123 or M.E. 123. One course. *Muga and J. F. Wilson*

161, 162. Interdisciplinary Resources for Community Problem-Solving. The objectives of this course are to assist the student in an understanding of the self, the interaction of the self with others and the environment, and in the analysis of information useful for decision-making. Problems in the community are used as a vehicle for developing group and individual approaches to the resolution of specific problems of interest to the students in the course. Prerequisite: permission of instructor. Two courses. *Artley*

169. Legal Aspects of Engineering. A course designed to introduce engineering students to those aspects of the law encountered in the practice of engineering. Subjects included are: contracts and specifications, real and personal property, torts, insurance, agency, equity, evidence, labor management, sales, expert testimony, engineering registration, and ethics. Open to seniors only. One course.

170. Proprietary Law for Engineers. Patents, trademarks, copyrights, trade secrets, and other forms of intellectual property are reviewed as individual and interrelated subjects. Representative law cases are assigned and discussed particularly as they affect engineering practice. Patent procedure is reviewed in some detail. Open to seniors only. One course.

171. Engineering-Economic Analysis. Methods of analysis applicable to the economic evaluation of engineering projects. Principles of engineering economics with regard to time dependent costs and benefits. Techniques of economic evaluation and comparisons of multiple alternatives. Concepts of welfare economics with regard to public works development. Identification and measurement of both monetary and non-monetary consequences of public works. One course. *Dajani*

172. Systems Engineering: Probabilistic Models. The purpose of this course is to provide an adequate foundation for application of probabilistic models to a variety of systems engineering problems. Emphasis is on the fundamental principles underlying various probabilistic models. Subjects considered are elementary concepts of probability theory and an introduction to decision-making under uncertainty with emphasis on the Bayesian approach to statistical

decision theory. Problems selected from several areas of application. Prerequisite: Math. 32. Spring semester. One course. *Kerr or Nolte*

173. Advanced Mechanics. Mechanical behavior of elastic, elastic-plastic, viscoelastic, and viscoplastic materials. Analysis of stresses and strains in simple structural elements, such as bars, shafts, beams, shells, and pressure vessels made of time-dependent and time-independent materials. Static and dynamic loading. Mechanical properties of solids under high rates of strain. Introduction to fracture mechanics. Brittle and ductile fracture, fatigue. Prerequisites: Engineering 83 and 75 or C.E. 73. One course. *Dvorak*

174. Technology Assessment and Social Choice. Economic, psychological, and ethical problems of optimizing design of technological systems; interaction of technology, society, and policy planning; conflicts between goals, institutions, public and private interests; citizen participation and feedback; impact evaluation; case studies in areas such as biomedical, communications, and computer technology. (Listed also as Public Policy Studies 174.) One course. *Garg and Clark*

175. Aesthetics, Design, and Culture. An examination of the role of aesthetics, both as a goal and as a tool, in a culture which is increasingly dependent on technology. Visual thinking, perceptual awareness, experiential learning, conceptual modeling, and design will be explored in terms of changes in one's sensory environment. Line, space, texture, color, and value will be experienced and analyzed through individual and group problem-solving and problem-formulating design projects. Fall semester. One course. *Pearsall*

183, 184. Projects in Engineering. Courses in which engineering projects of an interdisciplinary nature are undertaken. The projects must have engineering relevance in the sense of undertaking to meet human need through a disciplined approach under the guidance of a member of the engineering faculty. Prerequisite: permission of instructor. Two courses. *Engineering Faculty*

BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman;* Associate Professor Clark, *Director of Undergraduate Studies;* Professors Bennett, McElhaney, Nolte, Thurstone, and Wolbarsht; Associate Professors Barr, Hammond, and Wachtel; Assistant Professors Evans and von Ramm

Biomedical engineering includes the application of concepts and methods in the physical, mathematical, and engineering sciences to biology and medicine. This definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the undergraduate program in biomedical engineering is to permit students to prepare themselves for graduate work in biomedical engineering, medicine, or biology. This program is flexible and can satisfy the requirements for entrance to graduate work in engineering, physiology, biology, or to medical school.

Opportunities for student research are available in the following biomedical engineering laboratories: The Cardio-Respiratory Systems Laboratory includes a PDP-12 digital computer, a PAR signal averager, and an analog computer. Computer science techniques are utilized in acquiring, processing, and modeling biological data. Research in the Biomedical Materials Laboratory is directed toward the development of materials suitable for

use in biological environments such as the vascular system. Biomedical Engineering in Pediatric Cardiology measures electrical activity of the heart in animals and humans, to increase the basic knowledge of the heart itself. The Optics and Acoustics Laboratories are employed for research and instruction in the biomedical application of these fundamental areas. Ultrasound instrumentation measures and images biological tissue structures. The Neural Networks Laboratory explores the communication of information between individual nerve cells in prototypical brains. Optical, mechanical, and electronic equipment is used in recording neural activity, and computational equipment is employed for data analysis and simulation.

71. Discrete-Systems Analysis. Analysis of physical systems by linear discrete models with emphasis on methods suitable for digital computer usage. Convolution-summation, Z transforms, system transfer functions, and digital filters. Prerequisites: Math. 31 and Computer Science 51 or equivalent. One course. (Listed also as Computer Science 71.) *Pilkington*

125. Mechanics of Biological Materials. An introduction to mechanics of solid, semi-solid, and liquid material elements of biological tissues. The relationship of continuum properties to molecular arrangements will be made through statistical thermodynamics. Prerequisite: Engineering 135 or equivalent. One course. *Evans*

163, 164. Biomedical Electronics and Measurements. A study of the basic principles of biomedical electronics and measurements with emphasis on the operational performance and selection of transducers, instruments, and systems for biomedical data acquisition and processing. Selected laboratory work emphasizes the measurements of specific physiological events. Prerequisite: E.E. 63 or Engineering 72. Two courses. *Thurstone or Hammond*

172. Biomedical Transfer Processes. An introduction to transfer processes and life systems with emphasis on biological interactions of artificial materials and environmental studies. Prerequisite: Engineering 122. One course. *Clark*

181. Biomedical Modeling. Introduction to biomedical modeling with particular emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole organism level. Prerequisite: Biomedical Engineering 164. One course. *Wachtel*

187. Introductory Biomechanics. Static and dynamic analysis of biological systems, function and form, mechanical properties of tissues, human tolerance to impact and vibration, design of restraint systems, ejection seats and helmets. Prerequisite: Engineering 75 or equivalent. One course. *McElhaney*

191, 192. Projects in Biomedical Engineering. This course is available to seniors who express a desire for such work and who have shown aptitude for research in one area of biomedical engineering. Half-course to two courses. *Staff*

201. Analysis of Bioelectric Phenomena. Fundamentals of bioelectric modeling with particular emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole organism level. Not open to students who have had Biomedical Engineering 181. One course. *Wachtel*

202. Energy and Rate in Biological Processes. An introduction to biomedical thermodynamics and transfer processes with particular emphasis on

environmental studies, hyperbaric exposure, and the functions of natural and artificial organs. Not open to students who have had Biomedical Engineering 172. One course. *Clark and Bennett*

203. Bioelectric Potentials and Field Theory. A study of bioelectric potentials and models for their generation. Analysis from a field theoretic point of view with particular emphasis on formulations that are amenable to computation. One course. *Barr or Pilkington*

204. Real Time Measurement and Control of Heart Events. Specification of procedures and devices from biological considerations, and their design and construction. Consideration of amplifiers, analog-digital conversion, computer interfaces, and associated programming. Evaluation of selected examples for accuracy, complexity, and cost. One course. *Barr*

223. Biomedical Materials and Artificial Organs. The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. One course. *Clark*

225. Mechanics of Cellular Components. Concepts of solid, semi-solid, and liquid mechanics applied to the study of cell components, e.g., membranes, cytoplasm, organelles, nuclei, etc. Transition from molecular structure to continuum properties will be emphasized. Prerequisite: permission of instructor. One course. *Evans*

230. Biomechanics. Kinematic models of human motions, mechanical properties of bone and soft tissues, hydrodynamics of micturition, load directed growth mechanisms, human tolerance to impact and vibration, head injury criteria applied to helmet design. Prerequisite: permission of instructor. One course. *McElhaney*

233. Discrete Systems and Models of Computation. Difference equations, numerical approximation, and digital filters with particular emphasis on developing constrained models that are both physically reasonable and amenable to computation. One course. *Pilkington*

241, 242. Information Organization and Retrieval. Structure, analysis, organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching procedures, indexing, file maintenance, and methods for user interaction with the automated system. Programming experience included. Prerequisites: Computer Science 152. One course. (Also listed as Computer Science 241, 242.) *Hammond*

265. Advanced Topics in Biomedical Engineering. Opportunity for study of advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the chairman and the instructor under whom work will be done. One course. *Staff*

Departmental Major in Biomedical Engineering

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. The specific courses Biomedical Engineering 71, 163, 164, 125, and 172 must be included.

CIVIL ENGINEERING

Professor Muga, *Chairman*; Professor Brown, *Director of Undergraduate Studies*; Professors Dvorak, Utku, and Vesić; Associate Professors Palmer, Vesilind, and J. F. Wilson; Assistant Professors Arges and Dajani; Adjunct Assistant Professor Coffin; Instructor Hayward; Lecturers Behn and Rimer

Civil engineering involves the conception, design, analysis, and building of constructed facilities. However, the modern civil engineer may find himself engaged in such complex problems as trafficability of planetary surfaces, environmental planning for a community, or optimization of an urban transportation system. There are seven major speciality areas of civil engineering at Duke. Environmental engineering deals with the quality of human environment as affected by water supply and waste-water treatment and disposal. Geotechnical engineering is concerned with interaction between engineering structures and the earth's crust as well as with structures constructed of earth as a material. Mechanics and materials engineering is the study of the behavior of materials under various conditions of loading and environment. Ocean engineering deals with the development and use of water and marine resources. Structural engineering is concerned with economical and safe design of engineering structures. Urban engineering encompasses a broad spectrum of integrated technological problems such as land and city planning and development, mass transportation, and public health and safety. Water resources engineering is concerned with the usage, preservation, and replenishment of water resources. In addition, a student may elect a general program of civil engineering studies or an interdisciplinary program of management sciences combined with civil engineering. He may also pursue a degree with a double major in civil engineering and the policy sciences, by additionally satisfying the requirements of the Institute of Policy Sciences.

The civil engineering program at Duke is supported by several laboratories for instruction and research. The Structural Engineering Laboratory has universal testing machines with capacities to 400,000 pounds; hardness testers; and machines for testing torsion, fatigue, and impact. The department has facilities for the construction and testing of structural models, including medium-speed electronic equipment for the measurement and recording of strains and displacements. The Soil Mechanics Laboratory includes modern testing equipment and instruments, such as static and dynamic model testing accessories, as well as a triaxial shear apparatus, designed for testing soil and rock at confining pressures up to 100,000 pounds per square inch. The Fluid Mechanics Laboratory equipment includes a water wave flume with paddle-type variable frequency, constant amplitude, wave generator, and a variety of sensors. The Sanitary Engineering Laboratory is equipped for determining the characterization of waters and wastewaters and for applying biological, chemical, and physical treatment methods to improve their quality. The Materials Laboratory deals with the physical properties and stress-deformation characteristics of bituminous mixtures and concretes. The Urban Systems Laboratory is equipped with a PDP-8 digital computer and a teletype terminal. The department has a representative collection of modern surveying equipment.

16. Surveying for Engineers. The theory and application of measurements required for planning, design, and construction of engineered facilities. Transit-tape and stadia surveys; differential and profile leveling; traverse computations. Laboratory included. Not open to seniors. Corequisite: Math. 31. Half-course. *Arges*

23. Statics. Analysis of force systems and their equilibrium as applied to engineering systems; algebraic and graphic methods used with vector notation where appropriate. Corequisite: Math. 32. One course. *Staff*

73. Mechanics of Deformable Bodies. Stresses and strains in deformable bodies; mechanical behavior of materials and relation of stress to strain; applications of principles to static problems of beams, torsion members, and columns. Selected laboratory work. Prerequisite: C.E. 23. One course. *Arges*

116. Transportation Engineering. The role and history of transportation. Introduction to the planning and design of links, vehicles, and terminals of all transportation modes. Principles of traffic engineering and route location and design. Planning studies and economic evaluation. Prerequisite: junior or senior standing; consent of instructor for non-engineering students. One course. *Dajani*

117. Public Systems Planning. The systems approach to public policy planning. Mathematical modeling and computer simulation techniques. Estimation, forecasting, and decision-making. System evaluation models. Decision processes in the land-use, transportation, public utilities, and urban service sectors. Prerequisite: Math. 32. One course. *Dajani*

123. Water Resources Engineering. Hydraulics of pressure conduits and measurement of flow, compound pipe systems, analysis of flow in pressure distribution systems, descriptive and quantitative hydrology applied to problems of irrigation and drainage, open channel flow, reservoirs and distribution system storage. Selected laboratory work. Prerequisite: Engineering 145. One course. *Muga*

124. Environmental Engineering. Qualitative and quantitative physical, chemical, and bacteriological characterization of water and wastewater. Introduction to water treatment processes and wastewater collection, treatment and disposal systems; elements of environmental sanitation. Laboratory included. Field trips to be arranged. Corequisite: Engineering 145 or permission of instructor for non-civil engineering students. One course. *Vesilind and Rimer*

126. Sanitary Engineering Design. Design of facilities for providing an adequate supply of water of good quality, and means for collection, treatment, and disposal of municipal and industrial wastewaters. Location and design of treatment works. Field trips to be arranged. Prerequisite: C.E. 124. One course. *Rimer and Vesilind*

127. Environmental Pollution Control. A study of the environment—causes and effects of air, land, and water pollution. Interactions between the environment and stresses to which it is subjected as a consequence of growth and concentration of populations and their increasing demands on natural resources. Solid waste, recycling, noise pollution, and environmental ethics. For non-civil engineering students. One course. *Vesilind*

131. Theory of Structures. A first course in the application of mechanics to the analysis of plane and space structures; a unified treatment of statically determinate and indeterminate structural systems. Prerequisites: Math. 73 and Engineering 75. One course. *Brown*

133. Structural Design I. Nonhomogenous materials. Determination of physical and mechanical properties of construction materials. Theory and design of compression and flexural members. Emphasis on ultimate strength

theory for concrete. Timber design using mechanical fasteners, selected design problems in concrete to include form and timber supports. Prerequisite: C.E. 131. One course. *Palmer*

134. Structural Design II. Design in metals, primarily steel. Properties of materials as criteria for failure. Tension, compression, and flexural members. Riveted, bolted, and welded connections, including eccentric connections. Built-up members. Design by elastic and plastic methods. Selected problems to include computations and drawings. Prerequisite: C.E. 131. One course. *Palmer*

139. Introduction to Soil Mechanics. Origin and composition of soils, soil structure. Flow of water through soils; capillary and osmotic phenomena. Soil behavior under stress; compressibility, shear strength. Elements of mechanics of soil masses with application to problems of bearing capacity of foundations, earth pressure on retaining walls, and stability of slopes. Laboratory included. Prerequisites: Engineering 83 and 145. One course. *Vesić*

141, 142. Special Topics in Civil Engineering. Study arranged on a special topic in which the instructor has particular interest and competence as a result of research and professional activities. Prerequisites: permission of the instructor and the Director of Undergraduate Studies. Each half-course or one course. *Staff*

146. Professional Engineering. A study of general topics related to the professional practice of engineering with emphasis on economic and legal aspects. Monetary basis for engineering decisions, economic alternatives; contracts, specifications, ethics; quantity and cost estimates; scheduling by the Critical Path Method. Presentation of student papers on current or unique engineering topics. Prerequisite: junior or senior standing in engineering. One course. *Palmer*

173. Ocean Engineering. An introductory course to acquaint the student with the basics of physical and chemical oceanography and the need for and application of engineering knowledge and methods to the design and operation of structures, vehicles, and communication systems for use on land and in the oceans. Prerequisite: junior standing in any department. (Also listed as M.E. 173.) One course. *Linderoth, Muga and J. F. Wilson*

197, 198. Projects in Civil Engineering. These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: permission of the instructor and the Director of Undergraduate Studies. Each half-course or one course. *Staff*

201. Advanced Mechanics of Solids. Cartesian tensors, dyadics, and matrices. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. Corequisite: Math. 285 or equivalent. One course. *Dvorak*

204. Plates and Shells. Differential equation and extremum formulations of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian plates of isotropic and orthotropic material. Solution methods. Differential equation formulation of thin shell problems in curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution, and plates. Extremum formulation of shell problems. Solution methods. Prerequisites: Math. 104, and Engineering 75 or Engineering 135, or permission of instructor. One course. *Utku*

205. Elasticity. Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending, and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: C.E. 201 or equivalent. One course. *Dvorak*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible, continuous systems. (Listed also as M.E. 210.) One course. *J. F. Wilson and Macduff*

212. Mechanical Behavior of Materials. Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: C.E. 201. One course. *Dvorak*

215. Urban and Regional Geography. Human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive location decisions. Location and impact of constructed facilities. Spatial interaction and network structure. Geography of transportation and environmental quality. One course. *Dajani*

216. Transportation Planning and Policy Analysis. Issues in policy planning and decision-making in urban and rural transportation systems. Transportation legislation. Public transportation alternatives with emphasis on public transit and paratransit solutions. Prerequisite or corequisite: C.E. 116 or permission of instructor. (Listed also as Public Policy Studies 254.) One course. *Dajani*

217. Transportation Systems Analysis. The transportation systems planning process. Quantitative analysis, mathematical modeling and computer simulation techniques for short and long-range planning and evaluation of transportation systems. Prerequisite or Corequisite: C.E. 116 or permission of instructor. One course. *Dajani*

218. Engineering-Economic Analysis. Methods of analysis applicable to the economic evaluation of both pre-construction project plans and post-construction project outcomes. Principles of engineering economics with regard to time dependent costs and benefits. Techniques of economic evaluation and comparisons of multiple alternatives. Concepts of welfare economics with regard to public works development. Identification and measurements of both monetary and non-monetary consequences of public works. Student projects involving the analysis and evaluation of public investments. One course. *Dajani*

221. Incompressible Fluid Flow. Steady and unsteady pipe flow; theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluid systems; effect of resistance; tapered conductors. One course. *Muga*

222. Open Channel Flow. Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, flow into estuaries and bays. Design of open channel structures, river hyraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. One course. *Muga*

223. Flow Through Porous Media. Theory of miscible and immiscible fluid displacement processes. Derivation and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, and well point operation. One course. *Muga*

224. Coastal and Offshore Engineering. Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, and wave spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. One course. *Muga*

225. Engineering Hydrology. Study of processes governing the origin, distribution, and depletion and replenishment of water resources, and application of this knowledge to the solution of water supply and drainage problems. Topics include the hydrologic cycle, hydrometeorology, precipitation, runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. One course. *Muga*

231. Structural Engineering Analysis. The analysis of fundamental structural forms including arches, suspension cables and members of variable inertia. Influence lines for indeterminate structures. Introduction to matrix analysis. Prerequisites: C.E. 131 and Math. 104 or permission of instructor. One course. *Brown*

232. Reinforced Concrete Design. A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, and shear and diagonal tension. Two-way slab and flat plate design. Prerequisite: C.E. 133. One course. *Brown*

233. Prestressed Concrete Design. A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams, and columns; partial prestressing and composite design. Prerequisite: C.E. 133. One course. *Brown*

234. Structural Design in Metals. Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: C.E. 134. One course. *Palmer*

235. Foundation Engineering. An introduction to methods of analysis, design, and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; and underpinning. Foundation vibrations. One course. *Vesic*

236. Earth Structures. An introduction to methods of analysis, design, and construction of earth structures such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. One course. *Staff*

238. Rock Mechanics. Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock testing techniques. Prerequisite: C.E. 139 or permission of instructor. One course. *Staff*

241. Environmental Engineering Chemistry and Biology. Inorganic and organic chemistry as applied to water and wastewater treatment. Chemical equilibria and kinetics. Population dynamics and energy transfer in metabolic systems. Instrumental analysis, including spectraphotometry, chromatography, and atomic adsorption. Atmospheric chemistry and analytical methods. Prerequisite: C.E. 124. One course. *Vesilind*

243, 244. Sanitary Engineering Unit Operations and Process Design. Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and biotreatment processes. Two courses. *Vesilind*

246. Sanitary Engineering Design. The study of water resources and municipal water requirements including reservoirs, transmission, treatment and distribution systems; methods of collection, treatment and disposal of municipal and industrial wastewaters. The course includes the preparation of a comprehensive engineering report encompassing all aspects of municipal water and wastewater systems. Field trips to be arranged. Prerequisite: C.E. 124 or permission of instructor. One course. *Rimer and Vesilind*

247. Air Pollution Control. The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor, and air pollution law. One course. *Vesilind*

248. Solid Waste Management. Collection, treatment, and disposal of solid wastes from wastewater treatment. Filtration and centrifugation theory and application. Pumping of solid-liquid mixtures. Sludge conditioning by chemicals and heat. Sludge combustion, pyrolysis, and drying. Application of systems analysis to collection of municipal refuse. Sanitary landfills and incineration of solid wastes. Reuse and recycling. Prerequisite: C.E. 124 or permission of instructor. One course. *Vesilind*

250. Engineering Analysis. Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem-solving techniques. One course. *J. F. Wilson*

251. Systematic Structural Analysis I. Computer analysis techniques for the equilibrium problems of solids and structures. Describing the problems to a digital computer. Transformation matrices. Recapitulation of energy theorems. Stiffness and flexibility relations of structural elements in discrete space and continuum. Systematic analysis of equilibrium problems by displacement and force methods. Errors. Prerequisites: Math. 104, and CE 131 or Engineering 135, or permission of instructor. One course. *Utku*

252. Systematic Structural Analysis II. Computer analysis techniques for the equilibrium, eigenvalue and propagation problems of solids and structures. Representation of initial stresses. Handling of geometrical nonlinearities in equilibrium problems. Buckling. Handling of material nonlinearities. Incremental load techniques. Time dependent materials. Representation of inertial and damping forces. Stationary and transient vibrations. Random vibrations. Prerequisite: CE 251 or permission of instructor. One course. *Utku*

Departmental Major in Civil Engineering

The major requirements are included in the minimum total of 32 courses listed under the general requirements and departmental requirements. Specific courses which must be included are: Engineering 11 (half-course), 31, 75, 83, 123, 145; C.E. 16 (half-course), 116, 123, 124, 131, 133, 134, 139.

ELECTRICAL ENGINEERING

Associate Professor H. Hacker, Jr., *Chairman* (130 Engineering); Professor Marinos, *Director of Undergraduate Studies* (173 Engineering); Professors Artley, Kerr, Nolte, Owen, Pilkington, Thurstone, and Wilson; Associate Professors Joines and Wang; Assistant Professor George

Electrical Engineering is a broadly based discipline dealing with the processing, control, and transmission of information and energy by making use of the electrical and magnetic forces of nature. A partial listing of technical programs possible under the electrical engineering curriculum at Duke follows: communication systems, computer systems design, information science, electronics-networks, electromagnetics, physical electronics, control systems, energy conversion, applied mathematics, and applied physics. Students with interests such as premedicine, prelaw, computer science, management, economics, art and music, psychology and social systems may also be accommodated within the curriculum. These programs are individually designed and, in addition to stressing the acquisition of specific skills and methods, seek in both the classroom and laboratory to stimulate students to think creatively in terms of fundamental concepts.

Opportunities for research and project work are available in the following research and teaching laboratories: The Solid State Sciences Laboratories are concerned with both the microscopic and macroscopic properties of materials with emphasis on electric and magnetic phenomena such as magnetic susceptibility, paramagnetic resonance, electrical conductivity, and magnetic ordering transitions. In the Thin-Films Laboratory investigations are directed toward physical properties of thin films which provide bases for applications in electronic and computer systems. The Electronics Laboratory is used for the study of the physical behavior of basic electronic components and of advanced electronic devices and circuits. The Energy Conversion Laboratory is concerned with the generation, transformation, and control of energy in large-scale power systems and small self-contained systems. The Automatic Control Systems Laboratory deals with the principles underlying instrumentation and control of physical processes. The Spacecraft Systems Laboratory combines all phases of electrical engineering in solving problems encountered in modern spacecraft technology. The Controlled Personal Environment Laboratory provides experiential learning activities directed to the understanding of the self and the interaction of the self with others and a carefully controlled physical environment. The Machine Intelligence Laboratory is concerned with the design of adaptive and learning control systems for various applications. In the Electromagnetic Waves Laboratory studies are made of microwave networks and the interaction of electromagnetic waves with biological systems. The Minicomputer Laboratories provide the opportunity for hands-on experience in the operation of two small computers in an instructional and research environment. The Digital Systems Laboratories are utilized for research and instruction in digital systems design and simulation. The Adaptive Information Processing Laboratory is concerned with the formulation and performance evaluation of adaptive algorithms for extracting signals and information from noise.

11, 12. Undergraduate Research in Electrical Engineering. An elective program in which undergraduate students participate in an ongoing program of research with electrical engineering faculty members. The research topic pursued by the student is arranged by mutual agreement between the student and the participating faculty member. For freshmen only. Fall and spring semesters. One-quarter course. *Staff*

42. Introduction to Digital Systems. A course designed for students who have no previous exposure to switching (Boolean) algebra. Its main objective is to introduce basic notions of switching algebra and to demonstrate the application of these concepts to digital systems design. The operational characteristics of major digital subsystems such as memories, central processing elements, arithmetic units, and input/output devices are discussed in detail, and a general-purpose digital computer system with a simple architecture is functionally analyzed. Selected laboratory work is required. Fall and spring semesters. (Listed also as Computer Science 42.) One course. *Marinos or Owen*

43. Electronic Instruments and Devices. The theory of operation and applications of electronic instruments and devices most commonly used by scientists and engineers are presented. Topics include: d.c. and a.c. circuits, transducers, measurements, diode and transistor applications, operational amplifiers, and radiation detectors and generators. Three class sessions and one computation or laboratory session. Prerequisite: Math. 31. May not be taken concurrently with or after E.E. 63. Spring semester. One course. *Joines*

51, 52. Undergraduate Research in Electrical Engineering. For sophomores only. See E.E. 11, 12. Fall and spring semesters. One-quarter course. *Staff*

63. Electric Networks. The physical basis for electrical network models. Conductors and semiconductors; energy storage elements. Network topology and equations. Transient response due to initial conditions and step function inputs. Exponential forcing functions and the sinusoidal steady state. System functions; network theorems; power and energy in steady state circuit analysis. Prerequisites: Math. 32 and Physics 51 or permission of instructor. Fall and spring semesters. One course. *Kerr or Wilson*

101, 102. Undergraduate Research in Electrical Engineering. For juniors only. See E.E. 11, 12. Fall and spring semesters. One-quarter or one-half course. *Staff*

103. Introduction to Nonlinear Network Theory. Introduction to theory and techniques for analysis and synthesis of nonlinear circuits. Characterization of 2-, 3-, and n-terminal nonlinear network elements. Laws for interconnecting elements and determining equilibrium equations. Operating points, driving-point and transfer-characteristics plots. Graphical and numerical analysis and synthesis of d.c. and a.c. nonlinear resistive functional networks. Nonautonomous first-order nonlinear networks, and autonomous second-order nonlinear networks. Method of isoclines. Some laboratory and computer simulations. Prerequisite: E.E. 63. Fall semester. One course. *Wilson*

113. Introductory System Theory. Fourier series. Fourier and Laplace transforms; transfer function analysis. Impulse functions; impulse response of systems; convolution and time domain analysis. Discrete time models and computer simulation of continuous systems. Multiple input-output systems; introduction to state variable analysis. Prerequisites: E.E. 63. Fall and spring semesters. One course. *Kerr or Wang*

143. Fields and Continua. This course introduces the physical concepts used in the description of fields and continua and relates these concepts to mathematical descriptions which permit a quantitative treatment of phenomena of interest to the engineer. Physical fields include: fluid flow, thermal (heat flow), radiation, electric, magnetic, electromagnetic, and stress-strain fields.

Laboratory and computer applications will be used to assist in the learning of the material. Prerequisites: Math. 104 or 111 and Physics 52. Spring semester. One course. *Hacker or Joines*

151, 152. Undergraduate Research in Electrical Engineering. For seniors only. See E.E. 11, 12. Fall and spring semesters. One-quarter or one-half course. *Staff*

155, 156. Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and the instructor. Each half-course or one course. *Staff*

157. Introduction to Switching and Automata Theory. This course introduces techniques for the analysis and design of combinational and sequential networks. Discrete mathematical systems; elements of code theory; threshold logic; functional decomposition; minimum-complexity combinational and sequential networks; asynchronous and clocked sequential systems; iterative switching structures; Turing machines; and fault diagnosis techniques. Selected laboratory work. Usually open to juniors and seniors. Fall semester. (Listed also as Computer Science 157.) One course. *Marinos*

161. Electronic Circuits. Graphical and mathematical modeling of electronic devices such as diodes, bipolar-junction and field-effect transistors, and vacuum tubes; techniques for the analysis and design of electronic circuits with emphasis on graphical, piece-wise linear, and small-signal methods; applications of these methods to particular circuits, including regulators, bias-point stability, amplifiers, and switching circuits; computer simulation of electronic circuits using ECAP. Three class sessions and one computation or laboratory session. Prerequisite: E.E. 63. Spring semester. One course. *Wilson*

162. Electromechanical Energy Conversion. Principles of energy storage and conversion utilizing magnetic and electric fields; analytical treatment of dynamic equations of motion, including the Euler-Lagrange approach; applications to the design of electromechanical transducers and rotating machines. Three class sessions and one laboratory. Prerequisite: E.E. 113. One course. *Trickey*

164. Electromagnetic Fields and Waves. Electric and magnetic fields; Maxwell's equations developed from Coulomb's, Ampere's and Faraday's laws and the solenoidal nature of the magnetic field; electrostatics; magnetostatics; quasistatic and stationary fields; electromagnetic waves; retarded potential; relaxation time, reflection, polarization, and radiation of electromagnetic waves; transmission lines; probability waves in periodic structures. Three class sessions and one computation or laboratory. Prerequisite: E.E. 143. One course. *Artley or Joines*

173, 174. Projects in Electrical Engineering. A course which may be undertaken only by seniors who are enrolled in the Graduation with Distinction program, or who show special aptitude for individual project work. Prerequisite: permission of the Director of Undergraduate Studies. Elective for electrical engineering majors. Half-course to two courses. *Staff*

185. Pulse and Digital Electronics. Generation and shaping of waveforms encountered in information processing systems, such as radar, computer, control, and instrumentation. Typical circuit functions included are linear and nonlinear wave shaping, pulse and time-base generation, time delay, counting, and gating. Emphasis on the application of semiconductor devices to the

realization of circuit functions. Three class sessions and one computation or laboratory session. Prerequisite: E.E. 161. One course. *George*

186. Modulation Systems and Noise. Analysis and design of modulation systems. Description of deterministic and probabilistic signals; power spectra; sampling theory; amplitude-, frequency-, and pulse-modulation systems, and pulse-modulation techniques. Sources and characteristics of noise; comparison of various modulation techniques; comparison of various modulation systems. Selected laboratory work. One course. *Nolte or Owen*

188. Dynamics of Electrochemical Energy Conversion. An analytical and experimental study of the dynamic characteristics of electromechanical energy conversion devices that are utilized in both control and power applications. Three class sessions and one three-hour laboratory. Prerequisite: E.E. 162. One course.

196. Microwaves and Quantum Electronics. A study of the special field and circuit techniques required at microwave frequencies; electromagnetic wave propagation in unbounded and bounded media; transmission and reflection properties of various microwave networks. Equivalent circuits and matrix methods will facilitate analysis. Discussion of microwave amplifiers and oscillators, including klystrons, magnetrons, traveling-wave tubes, and masers. Selected laboratory experiments. Three class sessions and one computation or laboratory. Prerequisite: E.E. 164. One course. *Joines*

199. Linear Control Systems. Analysis and design of feedback control systems. Block diagram and signal flow graph system models. Servomechanism characteristics; steady state errors; sensitivity to parameter variations and disturbance signals. Time domain performance specifications. Stability. Root locus, Nyquist, and Bode analysis; design of compensation circuits; closed loop frequency response determination. Introduction to time domain analysis and design. Prerequisite: E.E. 113 or permission of instructor. Spring semester. One course. *Kerr or Wang*

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory; joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. Fall semester. (Listed also as Computer Science 203.) One course. *Kerr or Nolte*

204. Information Theory and Communication Systems. Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Spring semesters, 1976, 1978. Prerequisite: E.E. 203. One course. *Marinos or Nolte*

205. Signal Detection and Extraction Theory. Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Spring semester. (Listed also as Computer Science 205.) Prerequisite: E.E. 203 or permission of instructor. One course. *Nolte*

208. Digital Computer Design. Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detailed design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are also discussed. Prerequisite: E.E. 157 or permission of instructor. Spring semester. (Also listed as Computer Science 208.) One course. *Marinos or Owen*

211. Solid State Theory. A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrödinger and matrix formulations, angular momentum, perturbation methods, Maxwell-Boltzmann and Fermi distributions. Prerequisite: permission of instructor. Fall semester. One course. *Artley or Hacker*

212. Solid State Materials. Concepts of solid state physics as applied to engineering materials; electric, magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; superconductors. Prerequisite: E.E. 211. Spring semester. One course. *Artley or Hacker*

213. Principles of Magnetism. A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: permission of instructor. One course. *Artley or Hacker*

215. Semiconductor Physics. A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: E.E. 211 or permission of instructor. One course. *Hacker*

217. Masers. Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Prerequisite: permission of instructor. Some laboratory work. Spring semesters, 1977, 1979. One course. *George*

221. Nonlinear Networks and Systems. Characterization of nonlinear multi-terminal network elements, formulation of system equations from topological and energy considerations. Basic properties and general methods of solution of resistive nonlinear networks. Time-varying linear systems. Examination of some fundamental properties of nonlinear differential equations. Spring semester. One course. *Wilson*

222. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semester. (Listed also as M.E. 232.) One course. *Wilson*

224. Integrated Electronics: Analog and Digital. Application of integrated circuits for analog and digital systems. Topics include the effect of fabrication

techniques on circuitry design, a study of differential and operational amplifiers, and consideration of various logic families such as resistor-transistor logic (RTL), diode-transistor logic (DTL), current-mode or emitter-coupled logic (ECL), and transistor-transistor logic (TTL). Prerequisite: E.E. 161 or equivalent. Fall semester. One course. *Wilson*

225. Semiconductor Electronic Circuits. Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models; switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Spring semester. Prerequisite: permission of instructor. One course. *Joines*

227. Network Synthesis. Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Fall semesters, 1975, 1977. Prerequisite: permission of instructor. One course. *George*

241. Linear Systems. Modeling of multiple input-output linear systems in the frequency and time domains. Matrix differential and difference equations and their solutions; state variables. Digital simulation of differential systems. Fourier analysis of signals and systems. Transform techniques applied to state variable models. State space models of distributed systems. Fall semester. One course. *Kerr or Wang*

242. Modern Control and Dynamic Systems. See course description for M.E. 230. (Listed also as M.E. 230.) One course. *Wright*

243. Advanced Linear Systems Theory. Linear spaces and linear operators. Impulse-response matrices. Controllability and observability. Irreducible realizations of rational transfer function matrices. Canonical forms, state estimators, and observer theory. Stability. Linear time-invariant composite systems. Prerequisite: E.E. 241. Spring semesters, 1976, 1978. One course. *Wang or Kerr*

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and of instructor under whom work will be done. One course. *Staff*

266. Biofeedback Systems. Instrumentation, on-line computer analysis, and models associated with biofeedback systems. Selected readings will be considered in conjunction with experience in laboratory feedback practices. The physical, physiological, and psychological aspects of biofeedback provide a vehicle for experiential learning which relates individual experience to models used in systems theory, field theory, electronics, and communications. Undergraduate electrical engineering majors may not use this course as one of their 4 electrical engineering elective courses. Prerequisite: permission of instructor. Spring semester. One course. *Artley*

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, and force and energy relations. Three class sessions. Fall semester. Prerequisite: permission of instructor. One course. *Joines*

272. Application of Electromagnetic Theory. Propagation of electromagnetic waves in various structures and media; mathematical description of

microwave networks, including equivalent circuits and matrix methods; microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Spring semesters 1976, 1978. Prerequisite: E.E. 271. One course. *Joines*

Departmental Major in Electrical Engineering

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. The specific courses E.E. 63 and 113 must be included.

MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Professor Chaddock, *Chairman;* Associate Professor Shepard, *Director of Undergraduate Studies;* Professors Garg, Harman, Kenyon, Linderoth, Macduff, and Pearsall; Adjunct Professor Roberts; Associate Professors Clark, Cocks, Elsevier, and Wright; Adjunct Associate Professor Mayer; Assistant Professors Buzzard and Shaughnessy

In a modern technological society the profession of mechanical engineering has a three-fold role. The first, and traditional role, is the production of devices and machines. The products are as varied as the needs of mankind, from a mechanical toothpaste tube filler to a hydraulic turbine for harnessing tidal power or a home heating system powered by solar energy. The second role is one which has gradually evolved from the first, and now encompasses in-depth technical analyses and the design of complex engineering systems. Examples are nuclear power stations and ocean habitats for undersea exploration. The third role is one which involves the relationship between technological change and man's social, biological, and physical environment. It is no longer adequate to consider only obvious benefits and immediate costs. In addition, engineering solutions must be related to society's nontechnical needs and problems. If an educational program is to provide engineering leaders, it must respond to these broadening roles.

Historically, the available materials have limited the technological development of any age. The development of materials with particular combinations of mechanical, chemical, and electrical properties continues as a limiting step for technological advances on almost every engineering frontier. An especially crucial area requiring the skills of materials scientists and engineers is that of energy conversion. Needs exist not only in the overall production, distribution, and use of energy itself, but also in the development of less energy-consuming processes for the production of materials.

The undergraduate curriculum in mechanical engineering and materials science provides a broad base through specific instruction in the basic sciences and mathematics, engineering and materials sciences, analog and digital computation, mechanical design, systems theory, and engineering applications involving analysis, synthesis, and design. The search for viable solutions to mankind's problems also requires an engineer to interact with other professions and disciplines; to reach out for an understanding of the economic, social, health, and political consequences of engineering decisions. Elective opportunities in the social sciences, life sciences, and humanities departments help fill this need.

Undergraduate laboratories provide unique learning experiences and assist in the development of professional attitudes and approaches to typical engineering problems. In the System Dynamics Laboratory, fundamentals of instrumentation and dynamic responses are introduced through simulation techniques. The Materials Laboratory has equipment for the synthesis and

evaluation of metals, polymers, ceramics, and biomaterials. Experiments in the Fluid Mechanics and Heat Transfer Laboratories relate velocity and temperature field measurements to fluid friction and heat exchange processes. In the System Response and Control Laboratory computer simulation of feedback systems and familiarization with automatic control of hydraulic and pneumatic components is emphasized.

Involvement with mechanical engineering and materials science goes beyond any specific technology, device, or system. Based on the curriculum in this department, the student will experience the ways in which scientific knowledge can be utilized in the design and development of useful devices and processes. With the curriculum flexibility and the variety of course offerings, each student can choose a course of study most suited to his or her aptitude.

31. Engineering Applications of Digital Computation. Elements of automatic computation with emphasis on digital machines and use of FORTRAN programming language. Reduction of physical phenomena to mathematical models and solution of resulting equations using digital computers. Programming problems drawn from areas of engineering including basic physics and mathematics. One course. *Garg*

65. Energy: Problems and Promises. The objectives of this course are to survey the whole field of energy conversion and control, and to stimulate the student into thinking creatively and inventively about energy technology. Topics to be covered include: the energy crisis; energy sources and uses; thermodynamics, engineering approaches to energy conversion, nuclear and fossil fuel power plants; new energy technologies including solar, geothermal, wind, and tidal; transportable energy sources and energy storage systems. One course. *Chaddock, Cocks, Harman, and Shepard*

101. Thermodynamics. A rigorous development of engineering thermodynamics emphasizing the logical structure and manipulation. Classical and statistical concepts of the laws of thermodynamics. Energy and entropy analyses of thermodynamic systems. Property relationships. Chemically reactive systems. Application to power production and energy conversion. Prerequisites: Physics 51 and Math. 103. One course. *Elsevier or Harman*

102. Thermodynamics II. Review of the laws of thermodynamics and some of their consequences relative to energy conversion. Statistical concepts of the second law. Properties of real gases, gas mixtures, and solids. Generalized thermodynamic relationships. Combustion, thermochemistry, and chemical equilibrium. Applications to combustion power cycles, propulsion, and heat pumping. Prerequisite: M.E. 101. One course. *Elsevier*

111. Physical Metallurgy. Extension of the principles of Engineering 83 to the metallic state; atomic, experimental, and thermodynamic approaches to metallurgy; phase transformations and hardening mechanisms, relationships between the structure of alloys and plastic behavior with emphasis on engineering alloy systems. Prerequisite: Engineering 83. One course. *Shepard, Cocks, or Pearsall*

112. Polymer Science. Extension of the principles of Engineering 83 to high molecular weight polymers, especially those which have significant engineering applications; structure and properties of polymers; polymerization mechanisms; properties of commercial polymers; polymer processing. Prerequisite: Engineering 83. One course. *Clark or Pearsall*

113. Materials Science and Energy Technology. The limitations imposed

by materials problems on the development of new energy technologies. Nuclear power and thermonuclear fusion, solar power, magnetohydrodynamics, fuel cells, superconducting electric power generators, and geothermal systems will be studied together with the materials limitations of magnetic, dielectric, mechanical, and gaseous fuel energy storage methods. The role of materials technology in increasing the efficiency of conventional conversion methods will also be included. Prerequisite: Engineering 83 or M.E. 65. One course. *Shepard and Cocks*

123. Dynamics. General principles of dynamics as applied to particles, rigid bodies, and selected nonrigid systems with emphasis on the formulation of engineering problems. Absolute and relative motion analysis. Work-energy and impulse-momentum methods. Introduction to kinematics and kinetics in three dimensions and to Lagrange's equations using generalized coordinates. Prerequisites: Physics 51, Math. 103, and Engineering 75. One course. *Macduff or Wright*

126. Fluid Mechanics. An introductory course emphasizing the application of the principles of conservation of mass, momentum, and energy to a fluid system. Physical properties of fluids; dimensional analysis and similitude, viscous effects and integral boundary layer theory; subsonic and supersonic flows; normal shock waves. Selected laboratory work. Corequisites: M.E. 123 and 101. One course. *Shaughnessy*

135. Vibration Control. An introduction to the dynamics of mechanical systems; equilibrium, stability, and lumped and distributed systems. System analysis by classical differential equations, mechanical impedance, and computer methods. Prerequisites: Math. 103 and Engineering 72. One course. *Macduff*

136. Response of Systems. System design for optimum dynamic response. Development of mathematical models from physical systems, operational and computer techniques, matrix methods for lumped and distributed systems, instrumentation and testing of components and systems, effect of nonlinearities. Prerequisites: Math. 111, M.E. 123, and Engineering 72. One course. *Macduff or Wright*

141. Mechanical Design I. A study of the broad aspects of mechanical design starting with the creative process and considering the effects of economics, human factors, ethics, and prior art on design. Basic mechanical components such as gears, cams, bearings, springs, shafts, etc. will be introduced in the discussions so that the student will become familiar with their design and application. A term design project will serve to practice the application of the design process. Prerequisite: M.E. 123. One course. *Linderoth or Roberts*

142. Kinematics and Dynamics of Machinery. Study of the geometry of mechanisms. An introduction to the mathematics of gears, cams, linkages, and intermittent motion devices. The kinematics and kinetics of linkages. Computer solutions for linkage problems. Prerequisite: Math 73. Corequisite: Engineering 123. One course. *Linderoth*

143. The Design of Machine Elements. The detail design of machine elements. Study of the problems of stress and strain (deflections) as they affect and modify design requirements. Reliability and safety as design parameters. Prerequisite: M.E. 141. One course. *Linderoth*

150. Heat and Mass Transfer. A rigorous development of the laws of mass and energy transport as applied to a continuum. Energy transfer by conduc-

tion, in laminar and turbulent flow inside and outside of tubes, and by radiation. Application to heat exchangers, thermal power equipment, and heat transfer in the environment. Introduction to the principles of molecular diffusion and convective mass transfer. Use of the analogies between mass, momentum, and energy transfer in problem solving. Selected laboratory work. Prerequisites: M.E. 126 and Math. 111. One course. *Chaddock or Buzzard*

153. Heating, Air Conditioning, and Refrigeration. Principles of thermodynamics, heat transfer, and fluid flow applied to comfort and industrial air conditioning. Cycles and equipment for heating, cooling, and humidity control. Air transmission and distribution. Modern vapor compression, absorption, and low temperature refrigeration cycles and systems. Prerequisite: M.E. 101. One course. *Elsevier*

156. Combustion Engines. A study of cycles, fuels, and fuel mixtures in piston, ram jet, and rocket engines. Comparison of real and theoretical cycles; carburetion and fuel injection systems; and modern developments. Prerequisite: M.E. 101. One course. *Elsevier*

165, 166. Special Topics in Mechanical Engineering. Study arranged on a special engineering topic in which the faculty has particular interest and competence as a result of research and professional activities. Prerequisites: permission of the instructor and Director of Undergraduate Studies. Each half-course or one course. *Staff*

173. Ocean Engineering. An introductory course to acquaint the student with the basics of physical and chemical oceanography and the need for and application of engineering knowledge and methods to the design and operation of structures, vehicles, and communications systems for use on and in the oceans. Prerequisite: junior standing in any department. (Listed also as Civil Engineering 173.) One course. *Linderoth and Muga*

177. Computer Techniques for Simulation and Design. Optimization methods for engineering design. Unconstrained and constrained minimization procedures with linear programming shown as a special case of the gradient projection method. Computer solutions and design projects emphasized. One course. *Wright*

182. Fundamentals of Nuclear Engineering. Review of nuclear physics, nuclear interactions and cross sections, neutron induced chain reactions, shielding, hazards, isotope utilizations, reactor systems, and power reactors. Prerequisite: permission of instructor. One course. *Kenyon*

183. Power Plants. Basic concepts of thermodynamics, heat transfer, and fluid flow are combined with industrial data for the consideration of real power plant problems. Selection of steam generators, prime movers, fans, pumps, heaters, and piping systems with regard to engineering, economic, and environmental points of view. One course. *Kenyon*

197, 198. Projects in Mechanical Engineering. This course may be assigned by the chairman of the department to outstanding seniors who express a desire for such work and who have shown aptitude for research in one distinct field of mechanical engineering. Prerequisites: *B* average and senior standing. Half-course to two courses. *Staff*

202. Theoretical Thermodynamics. Review of classical thermodynamics. Thermodynamics of continuum properties of real substances. Analysis of energy conversion with internal irreversibility and advanced engineering problems. Introduction to the statistical basis of thermodynamics. One course. *Harman*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible, continuous systems. (Listed also as Civil Engineering 210.) One course. *J. F. Wilson or Macduff*

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention is paid to recent developments in the processing and use of modern plastics and fibers. Product design is considered in terms of polymer structures, processing techniques, and properties. One course. *Pearsall or Clark*

213. Advanced Materials Science. An in-depth study of current problems in materials applications conducted in a seminar format. Treatment will include thermal, electrical, optical, and magnetic properties of materials in terms of basic physical concepts. Subjects intended to provide materials scientists and engineers with a theoretical basis for understanding and manipulating properties. Prerequisites: Engineering 83 and M.E. 111 or 112. One course. *Cocks, Pearsall, and Shepard*

214. Corrosion and Corrosion Control. Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. One course. *Cocks and Shepard*

215. Failure Analysis and Prevention. A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or permission of instructor. One course. *Cocks and Shepard*

221. Compressible Fluid Flow. Basic concepts of the flow of gases from the subsonic to the hypersonic regime. Effects of friction, heat transfer, and shock on one-dimensional inviscid flow. Potential theory, oblique shock waves, and special calculation techniques in two-dimensional flow. One course. *Harman*

222. Heat Transfer. Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. One course. *Chaddock or Buzzard*

224. An Introduction to Turbulence. Flow instability and the transition to turbulence. Physical characteristics of turbulent flows, averaging, and the Reynolds equation. Turbulent transport and mixing length theories. The statistical description of turbulence, correlations, and spectra. Fourier transforms. Measurement techniques. One course. *Shaughnessy*

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. One course. *Shaughnessy*

230. Modern Control and Dynamic Systems. The statespace point of view is used as a vehicle to integrate the classical control and modern systems techniques. Topics include vector differential equations, modal matrix transformation, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. One course. *Garg and Wright*

231. Systems Response and Control. Methods, applicable to design, of obtaining parameters for strength, response, and stability studies of mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. One course. *Macduff or Wright*

232. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semesters. Prerequisite: permission of instructor. (Listed also as E.E. 222.) One course. *T. Wilson*

233. Fluid Control Systems. A design oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; d.c. and a.c. hydraulic and pneumatic amplifiers. One course. *Macduff*

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. One course. *Macduff*

236. Engineering Acoustics and Noise Control. Specification of the physical properties of noise, noise measurement, and absorption, transmission, and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personnel protectors. Prerequisites: M.E. 123 and Math. 111. One course. *Macduff*

251. Refrigeration and Cryogenics. Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Thermodynamics of vapor compression, air cycle, absorption, and thermoelectric refrigeration. Production of low and very low temperatures, helium liquifiers. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. One course. *Chaddock*

255. Energy Conversion. Principles, thermodynamics, and classification of energy conversion devices. Introduction to semiconductors, thermoelectric generators, photovoltaic generators, thermionic generators, magnetohydrodynamic generators, fuel cells, and other energy conversion devices. One course. *Harman*

265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and the instructor under whom work will be done. One course. *Staff*

270. Theory of Lubrication and Bearing Design. A study and analysis of the theory of hydrodynamic and hydrostatic lubrication will be presented. The dynamics of bearing loading, bearing design, and materials will be examined in their relationships to the theory of lubrication. Properties of lubricants will be reviewed. The student will have ample opportunity to put theory into practice with real bearing problems taken from industrial machinery, construction equipment, transportation media, and wherever relative motion is required between adjacent surfaces. One course. *Linderoth*

280. Nuclear Reactor Power Cycles. Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety shielding, heat transfer, fluid flow, and materials problems unique to reactor design. One course. *Kenyon*

Departmental Major in Mechanical Engineering and Materials Science

The major requirements are included in the minimum total of 32 courses listed under general requirements and departmental requirements. Specific courses which must be included are: Engineering 72, 75, 83; M.E. 101, 123, 136, 141, and either M.E. 126 and 150, or M.E. 111 and Engineering 122.





Appendix

DEGREES CONFERRED MAY 12, 1974

Bachelor of Arts

David H. Abbott
Julie Roberta Adie
Ricardo Antonio Agurcia Fasquelle
Leland Aiken
Jan Ajemian
Bruce Mark Albert
Jane Castor Albertson
Robert Wayne Albright
Anne Davis Alexander
Suzanne Allen
Margaret Susan Allison
Steven Allocca
Austin Murphy Allran
John Marshall Alton
Barbara Alice Amen
William T. Anas
Deborah Biddle Andrews
Susan Toy Andrews
Mary Elizabeth Ansley
Jeffrey W. Appelbaum
Diane Leigh Appleton
Nancy Joan Arvay
William John Arvay, Jr.
Jane Gay Ashton
Jane M. Atwood
Elliot Scott Auerhahn
James Monroe Avent
Emily Jean Averill
Benjamin Jack Baier, Jr.
David Bratt Baker, III
Michael S. Baker
Celia Tolar Bane
John Greathouse Bane III
Bonnie Gale Banks
David Alan Bankus
Ronald Evan Barab
David Storey Barnes
Michèle P. Barragan
Robert Charles Barrett
Catherine Jeanne Barrie
Wendy Dobbs Bartel
Daniel Joseph Barth
Roberta Karolyn Bartow
Richard Herman Basch
David Alan Baur
Louis Anthony Baviello
James A. Beales, Jr.
Christopher Wagner Beck
James S. Peter Beck III
Janet Roberta Beck
Marjorie Ruth Becker
Nancy Scott Becker
Steven Kline Beckner
Douglas Gordon Beckstett
Robert Francis Bencze
Meredith Bennett
Katherine Ellen Benson
Sandra Dale Benson
Jane Alethia Hewitt Berlin
Robert Eric Bernstein
Donald Nelson Black
Kenneth Alexander Black
Richard Gladstone Black
Steven Davis Black
Bruce Frederick Blakely
Deborough Gail Blalock
Constance E. Blankenship
Joan Sally Blick
Allison Armstrong Blount
Julie Ellen Blume
John Harbin Boddie
Linda Bogatko
Valerie Ann Bond
Robert Coy Bonner, III
Joesph Allen Boone
Mark N. Boorman
John Jay Bostock
Constantine George Bouchlas
Rebecca Elizabeth Bowen
Stanley Gatewood Brading, Jr.
Elizabeth Brahana
Deborah Margaret Brand
William David Brantley
Joyce Ann Brauer
Michael James Breen
Stephen Walter Brewer
Richard E. Brienza
William Dennis Briggs
Diane Edward Britz
Jarvis Dean Brock
Deborah Jeanne Brooks
James Richard Brotherson
Melville Stewart Brown
Paula Jean Brown
William Moore Brown
Fred Boyd Bryant II
John Emory Buckey
Thomas Michael Bulle
Pamela Anne Bump
Barbara Ann Bunce
William B. Bunn III
Jeffrey J. Burdette
Stephen Franklin Burgess
Andrew Irving Burness
Philip Joseph Butera
Pam Brinkley Burton
Barbara Ann Buzun
James Allen Byerly
Deborah Lea Byrd
Janet Marietta Byron
Michael David Calhoun
Howard Hollis Callaway, Jr.
Nancy Margaret Campbell
Douglas Bernard Carlson
Patricia Blythe Carroll
Joseph Tinnie Carruthers III
Susette DeBow Carter
Irene L. Carver
Michael Andrew Castle
Karen Lee Cato
Arlene Barbara Chambliss
John Thomas Cheek
Gregory A. Chizmar
Margaret Ann Chowning
Deborah Anne Ciacci
Mary Lee Cittadino
Susan Mason Clapp
George Philemon Clark III
William Robert Clarke
Patricia Anne Clement
Jeanne Frances Clifford
Wayne Odell Clontz
John Wesley Clower
Virginia Ann Cocheu
Kimberly Pleasant Cochrane
Charles Gilbert Cofer
Stacy Norman Coggins II
Joseph Randolph Colahan
Janet A. Colm
Jesse M. Colvin
Joseph Louis Compitello
Jere Confrey
Brian S. Conneely
Ross Jordan Connelly
Miston Myron Constam, III
Caroline Lucile Cook
Michael Anthony Cooke
Edward Anthony Cooley
William Scott Cooper
Luther Clifton Copeland, Jr.
Martha Jean Copony
Charles Edmond Cox
David Clinton Crago
Carol P. Cramer
Christopher Jack Cramer
Patrick Thomas Crane
John Randolph Cranford
David Warren Cuddy
Diane Beatty Culp
Lewis Valentine Curran
Alan Stuart Currie
Paul Milton Currie
Carl England Curry
Edward Lee Curtis, Jr.
James August Cutrara
Sherry L. Dailey
David B. Darling
Sharon Jane Darragh
Ralph Maurice Davis
William Stanford Davis

Allen Warren Dawson, Jr.
Marc Harry Dawson
Barbara J. Deal
Charles H. Dearborn, III
Marian Allayne DeBerry
Phyllis Anne DeCarlo
Brian Richard DeLong
Marsha J. DeLong
Margaret Deuel
Warren J. DeVecchio
Lucille Anne DiBello
Drew Stewart Diehl
Eugénie Michelle Dieringer
David Schnepfe Diggs
Craig Scott Dillman
Robert Charles DiPasquale
Philip Allan Disque
Thomas Edward Dittmar
Robert Harry Dixon
Nathan Lee Dodson
Rennold Wayne Domske
Sharon M. Dorsey
Wayne Jeffrey Dow
Samuel Dickerson Martin Downing
Keith Barry DuBoff
Martha Miller Dudley
Nancy Knight Duggins
Henry Clark Duncan, Jr.
Elaine Alice Dunn
James Harold Durfee, Jr.
Richard Michael Durrer
Anne Rouse Edwards
John Paul Edwards, Jr.
Susan D. Edwards
Joan Angela Egasti
David Mark Eisenberg
Richard Lewis Eisenberg
Martha L. Elks
Martha Jane Elson
Damon Louise Elster
Patricia Winslow Emlet
Anne S. Emmenegger
Gwen Enfield
Marilyn Elizabeth Engle
Barry Wayne Enholm
Eric Frank Ensor
Betty Joyce Erb
Linda Louise Erwin
Donald McGee Etheridge, Jr.
Robert Benson Euler
Ann Exley
Edward John Falcone
Jo Ann Farrington
Toni Francesca Fascell
Alwyn Louis Featherston, Jr.
Craig Michael Feeney
Janet Susan Ferrigni
Susan Lynn Fetter
Diane Christina Figueroa
Richard James Fildes
Robert Bryce Fisher
Barbara Knowlton Fite
Sharon Ann FitzGerald
Patricia Lynn Fleming
Victoria Jane Fleming
Steven Richard Fletcher
Charles Reider Fliflet
Joseph Atchison Florence IV
Ricky L. Floyd
William Ross Foote
John Bassett Ford
Virginia Rutledge Forney
Cynthia P. Forrester
Walter Earle Fowler
Harold L. Frank
Peter Martin Frank
Randall T. Frattini
Alice Irene Frell
Milton William Frenzel
Andrea Kanon Frey
Henry Philip Frieder
Robert B. Frincke, Jr.
Thomas David Fuchs
Manley Kearns Fuller III
Jane Letitia Gabriel
Junius Michael Gaither
Martha Young Galloway
Jean Gloria Gamble
Kurt Lee Gandenberger
Katherine Anne Gant
Mark E. Garber III
Alison Mills Gardner
Ben Cox Garrett
Jenny Lee Garrison
Gregory Ryan Garvin
Joseph Owen Gehrett, Jr.
Bruce R. Genderson
Gilbert Julius Genn
Patricia Ellen Gerber
Daniel Nelson Gerin
Lee G. Gersch
John Jeffrey Gibbons
Charles R. Gibbs
Jeanne Christine Gibson
Stephen M. Gibson
Roxanne Lucile Gilman
Torrey Allen Glass
Douglas Edward Glenn
Joel Steven Goldberg
Jacob Bowles Golden, Jr.
Joan Bernadette Golden
Jacob Marc Goldman
Richard P. Goldstein
Joel Goodman
Thomas Hammond Gorey
Vicki Annette Goss
Gail Dian Goundry
James A. Grasso
Elizabeth Enid Gray
Christopher Barcroft Graybill
David W. Greenleaf
David M. Griffith
Keith Hugh Gross
Gayle Beth Grossman
Kathryn Greer Gulnac
Patricio Gutierrez
Richard Bryce Hadlow
Andrea Regina Hahn
John Stephen Hahn
Roger William Hale
Christina Hall
Elizabeth Marie Brunner Hall
Lida Rogers Hall
Susan Jean Hall
Elizabeth Hewitt Haller
Susan Haltiwanger
Mary Sue Hamann
Rufus Roberts Hambright, Jr.
Karen Marie Hammett
Stephen H. Hamrick
Michael C. Hamschin
Kenneth D. Hancock
Kathleen Marie Hanigan
Mary Elizabeth Hapala
Jeffrey K. Haring
Ann Louise Harris
George Alfred Harrison
Jeffrey Dietrich Harrison
Jon Julian Harrison
Hazel May Hartsoe
Kathleen Ruth Harward
Jean Elizabeth Haworth
Edward Joseph Healy
George Marshall Hearn, Jr.
Lucy Luetta Heffner
David Barclay Heinz
Deborah Lisa Helms
Elizabeth Earon Hendrix
Lee Hampton Henkel III
James LaNauze Hill
Patricia Ann Hill
Melody Hinds
Michael Tad Hippler
P. Thomas Hirsch
Randall D. Hobbet
Frederick William Hockenjos
Janet E. Hodde
Johanna Weiland Hoehl
Holly Elizabeth Hoffman
Thomas Gordon Hoffman
Amy Dale Hogue
Edgar W. Hollomon
Mary Ruth Hook
Harold LeVaughn Hooks, Jr.
Barbara Hall Hoover
Edward Charles Horne
Frank Steven Horsley
Margaret Rhoads House
Mark Reid Howard
Mei-Ku Huang
Shelley Maleen Huff
Patricia Percival Hughes
Donald Frank Hull III
Marvin D. Hursey
Richard Thorne Hurt
Nancy Ann Hutchinson
Clinton Brunson Hutto, Jr.
Lindsay Ideson
John Stanton Ireland
James Marx Iseman, Jr.
Marian Lynn Isenhower
Michael Stuart Ives
Laurie Ivins
Catherine Jean Jacobs

Cris W. Jacobs
Gregory Randall Jacobs
Jonathan G. Jacobson
Carol Ann Jaffe
Carolyn Evans Jarrell
Robert Alan Jarrow
Julie Jetton
David Murray Jeuda
Candace Marie Johnson
Craig Maynard Johnson
Renee Louise Johnson
Robert Bruce Johnson
Stephen Morgan Johnson
Robert William Johnston
Lawrence Morel Jones
Richard M. Jones
Russell Everett Jones
Sidney Craig Jones
Susan Alice Jones
Edward Goode Jordan
Mark Wallace Jorgenson
John J. Kador
Michael George Kam
Jean Ann Kanik
Debra Lynn Kasper
Robert Charles Kaufman
Harry Joseph Kaufmann, II
Stuart Dodds Kearney, III
LeRoy Heany Keeler III
Lawrence Scott Keller
Linda Anne Kelly
Nicholas DeWayne Kelly
Shawn Lunney Kelly
Wayne Richard Kempson
Michael Earl Kenna
William Arthur Kennedy
Clark Russel Kerr III
H. Keith Kiley
Dennis Jackson King
Judith Ann King
Kenneth Patrick Kirk
Alice L. Kirkman
Sonya Annette Kirkwood
Steven Michael Klebanoff
Olga Christine Kleinsasser
Darren H. Kloomok
Robert Norman Knight, Jr.
Thomas Eugene Knupp
Martin Robert Koch
Stephen George Koerner
Allison J. Krahling
Jonathan Theodore Krassny
Shane James Kraus
Larry Allen Kubal
Joel Jess Kubli
Robert Richard Kuehn
Marsha Jean Kuhn
Frederick Charles Kulow, Jr.
Stephen Henry Kupperman
Edward Lyell Kurth
Stephen Charles Kurachek
Gary Scott Lachman
Dennis R. La Fiura
Richard G. Lagueruela
Donna Irene Lamb
Katherine Hardison Lamb
Adrienne Clare Lang
Vladimir Lanitis
Raymon E. Lark, Jr.
A. Troy Lassiter, III
Kenneth Walker Latta
Edward Steven Lauer
Christopher John Lauzen
Elizabeth Lawrence
Jack Amory Lawson, Jr.
John Henry Leavens
Marie Therese Lee
Helga Lura Leftwich
Nels R. Leininger
Joel Jay Lerner
Linda Leslie Lewis
Stephen Russell Lewis
Alexander C. Lichtler
Lisa Linkhaw
Ann Brennan Little
Joan Kay Little
Pamela Ann Little
Louella Ann Lloyd
Theresa Anne Lloyd
Katherine Porcher Lockhart
Lawrence T. Loeser
William Thomas Lohmann
George Stanley Long
John Robert Long
Scott Wilson Loring
Stanley Joseph Lourdeaux Jr.
William Craig Lutton
Evelyn McMaster Lyles
Judith Mapes Lyman
Anthony Joseph Lynn
Melanie Sue Lyons
Mélanie Hammond Mabey
Mark David MacFarlane
Mark E. Maddocks
Euliss Dale Madren
Mary Melinda Malik
Jon Jay Manger
Kathryn J. Mann
Susan Marjorie Marcyes
Bruce Edward Markgraf
Mary Elizabeth Markham
Wendy Lynn Marshall
David Leon Martel
Curtis W. Martin
Hilary Jane Martin
Louise Linda Martorelli
Bruce Alfred Maser
Randall Sherman Mason
Paul Joseph Mass
Karrie Ferguson Massee
Paul S. Massimiano
Katherine Page Matheson
Paul Aaron Matthews
Lynn Paula Mathieu
Penelope Judith Maunsell
Norman Lee Mauroner, Jr.
Michael Sobeloff Mayer
Christine Bailey Mayfield
Joanne Lynn Mazurki
William Michael McCabe III
Susan Jane McClellan
Mary Louise McClinton
Robert Olmsted McCloud, Jr.
Elizabeth Ann McCraken
Rayburn Latimer McCulloh
Neill Allen McDonald
Robert Stanley McDuffie, Jr.
Georgia Ann Haller McElroy
Craig Donald McEwan
Richard E. McFayden
Lockie Jayne McGehee
Kevin C. McKinney
David Proctor McKnight
Steven Dana McLamb
Mary Darden McLeod
Daniel P. McMahon
Lavonne Adele Meads
Beverley Harper Means
Craig Lee Meisel
Stephen Gary Melcer
Richard Alan Melcher
Margaret Ellen Melville
Howard N. Menaker
Christopher Erler Meyer III
Morgan Paul Meyer
George Edward Michael
Judith A. Migliori
Felix Franklin Miller, III
James Thomas Miller
Wendy Karen Miller
Nancy Lee Milner
Susan Carmichael Milner
Christopher Warren Mims
William Kenneth Miner
Henry Hanley Minor III
David Alan Mishkin
Llewellyn Browder Mohorn
James Lewis Moore
Sarah Elizabeth Moran
Joanne Rogers Moreen
Larry Joe Morell
Beth Karen Morgan
Kathleen Barlow Morgan
Mark Lewis Morgan
Jacques Roland Morin
David Clarence Morris
Elizabeth Harvey Morris
James Lee Morris
Charles Eric Mortensen
Rose M. Motley
Peter Lockhart Mullen
Nancy J. Muller
Denise Aline Mummert
Charles Reginald Munday, Jr.
Heather Murphree
Jane Maurine Murphy
Timothy Michael Murray
Michael Archie Musselwhite
James R. B. Nashold
Henry P. Nathan
Carla Ann Neeley
Barbara Kit Nelson
Clifford Howard Nelson, Jr.
Neil Stanley Newhouse
Paula Beth Newman

Carol Lynn Newsham
Anton Peter Nielsen II
Martha Ann Shindelman Noe
Michael Christopher Nolan
Nancy Kathleen Norris
Margaret Lynn Norsworthy
Christopher Colt North
Jeremy Kenneth O'Brien
Lydia Ann Ochoa
Mary Jane Olive
Robert Kirk Oppenlander
John Hunter Orr
Brian Edwin Otto
Katharine Cumming Otto
Katherine Fai-Kuen Ou
L. Elaine Overall
Samuel A. Owen, Jr.
Christian Paletta
Nancy A. Palmer
Petrea Bell Palmer
Frances Patricia Papa
Betty Lyn Parker
Jon W. Parker
Bonnie Katherine Parr
Jane Wylie Patrick
Deidra Margaret Patton
Cynthia Louise Pauley
William Henry Pauley III
Anna Beth Payne
Gloria Jean Payne
Lesli Drew Peake
Roberta Ellen Pearson
Alfred O. Peeler
Ann McLean Pelham
Diane M. Pelrine
Robert Read Penn
Kenneth Landon Peoples
Dorothy Marie Peteet
Barbara Jane Pettit
Charles Valuet Phillips III
James Gordon Philipson
Mark Henry Pickett
Rachel Allen Pickett
Gary Richard Pickus
Mary Frederick Pine
Michael David Plonowski
John W. Poff
Rosilyn Harris Polan
Roy P. Polayes
Stephen Elliott Poole
Samuel S. Popkin
Priscilla Elizabeth Porch
Jennifer Jill Porter
Paul C. Porter
Nancy Ann Powers
Todd M. Powers
Marianne Pownall
Carolyn Annette Prescott
Ceil Estelle Price
Kerrie Lynn Protsman
Linda Robin Provus
Walter Cleveland Putnam, III
John P. Quinn
Nina Marie Radakovich
Shawn Gordon Rader
Robert Jay Raider
Francis Joseph Rainey Jr.
Richard Ravits
Owen Walker Reagan, III
Jonathan B. Red
James Christopher Redding
Richard Sumner Reese
Robert Norman Reeves, Jr.
Katherine Louise Katz Register
Roddey Reid III
Stephen Ian Reinstein
Donald Walter Reneau
Benjamin James Reynolds
Karen Margaret Rhodes
Marshall H. Rich
George Michael Richards
Carol Marie Richmiller
James Parrish Roach
Virginia F. White Roark
Deborah Kaye Roberts
Allyn Banks Robertson
John Martin Robinson
Patricia Birch Robinson
Thomas W. Robisheaux
John Arthur Rockwell
Nancy Elaine Rodriguez
Daniel Allen Rogers
Walter Russell Rogers, Junior
David Andrew Rosenberg
Cheryl Anne Rouge
David Beryl Rubin
Herbert Charles Rubright, Jr.
Orrin Kenneth Rudd III
Emily Beth Rudin
William F. Ryan, Jr.
Judith Rose Sacks
Robert Gardiner Salisbury,
Mark Fraser Sammis
John D. Sample
Christie Barnes Sanders
Stagg Nicholson Sanders
Barbara Ellen Sanderson
Edward Paul Sands
Jack Michael Saul
Steven Robert Joseph Savona
Debra Susan Scherner
Thomas Richard Schlegel
Robert John Schmidt
Jeffrey Scott Schneider
Robin Leslie Schnitzer
Christine Adele Schoenberg
Lee D. Schrepple
Catherine Logan Scott
Denise Gay Scott
George William Scott, III
Raymond Parent Scott III
Richard Waldo Scott
William Gavin Scott, III
William D. Searles
Elizabeth Langsford Sears
Linda Bernice Secord
Larry Marc Segall
Stephen Lee Selby
Mary Anne Henschen Settle
John Robert Shannon
Howard Shapiro
Kenneth Eric Shapiro
Laurence J. Shapiro
Sharon Andrews Sharp
Barbara Jean Shaw
Jane Elizabeth Shaw
Robert Hill Shaw III
Joanna Reed Shelton
Darlene Kaye Shenton
Joanne Carol Shepard
Kenneth A. Shifrin
Mary Agnes Shoffner
Richard Painter Shryock
Eve J. Silberman
Roberdeau Dunn Simmons
David Raymond Simonsen, Jr.
Christopher Wells Eaton Slitor
Barbara Louise Sloan
Gaston Elvin Small, III
Margaret M. Smart
Arthur L. Smith
David Franklin Smith
Deborah Holcomb Smith
Gregg Sherwood Smith
Gregory Norman Smith
Helen Andrews Winifred Smith
Herman Dabney Smith II
Janice Marshall Smith
Jerome Robert Smith
John Russell Smith
Louise Price Smith
Thornton Sidney Smith
Victoria Hull Smurthwaite
Madison S. Spach Jr.
Gail Louise Spaid
Reed Spangler
Margaret Anne Spigener
Robert John Stabe
Laura Louise Stafford
Donald W. Staley
Gordon Eugene Stanley
Theodore Allan Stanley
Beverly Christine Starks
Keith Jeffrey Starnes
Laurie Virginia Stauffer
Rachel L. Steele
David Barry Stein
Herbert Roland Stender III
Paula Anne Stephanz
Adam Sternberg
Ernest William Sternberg III
Bruce C. Stevens
William H. Stevens
John K. Stewart
Harold E. Stine, Jr.
David Alan Stirling
John Joseph Stocker
Guillermo M. R. Strauss
Sheila Marie Street
Sigrid Anne Strong
Deborah Lynne Struchen
Klaus-Dieter George Struzyna

Sara Kathryn Sudduth
Daniel Joseph Sullivan, Jr.
Michael John Francis Sullivan
Glenn E. Summers
Orville R. Surla
Marshall Ann Sutton
Margery Sue Sved
George Harry Swain, Jr.
Priscilla L. Swalm
Jay Kent Sweezey
Barbara Anne Tapp
Robert S. Tate
Ellen Joan Tchorni
Jennifer W. Teschner
Jeffrey S. Tharler
Ellen Margaret Thompson
Michael Warren Thompson
Nancy Sue Thompson
Ann Taylor Thornton
Janet Elizabeth Tickler
Stephen Murray Todd
Sally Austin Tom
David Robert Tomasetti
Nancy Katherine Tomlinson
Janet Eve Tonka
Nancy Landis Tophàm
Thomas F. Torrey Jr.
Nill Victor Toulme
D. Bruce Townsend
Robert Duàne Tretter
Steven Henry Tulsky
Lance E. Tunick
Paul L. Tunis
Jeffrey C. Tyler
Sarah Kuhlmey Uihlein
Gail Lynn Unterberger
Louise Gordon Upchurch
Craig Arnold Updegrove
Ricardo Franklin Urrutia
Linda A. Usdin
Henry Lewis Valk, Jr.
Charles Michael van der Horst
Marsha Lynn van Lawick
Jay Palmer van Santen
Sara Elizabeth Via
Mary Margaret Glennon Vincent
Deborah Foster Vining
Joseph Vincent Vogel
Mary Jane Vogel
Jack Duling Vollbrecht
Bruce Lindsay Vor Broker
Sandra Jane Waldorf
Betsy Ellen Walker
Cornelia Kip Walker
John Lockwood Walker
Susan Jane Walker
Daniel E. Wallace
Mark Raymond Walling
Richard Kent Waln
Stephen Arnold Wank
Catherine F. Ward
Clark Anderson Ward
David J. Ward
David Wendell Ward
Calvin Warren
Peter Bayard Wears
Thomas Blumeyer Weaver
Thomas William Weaver
Carol Jean Lee Webb
Margaret Hall Wieskotten
Richard Jon Welch
Linda Adèle West
James Samuel Westfall
John Gould Whaley
Betsy Ann White
Jennie Kathleen White
Faith Elizabeth Whitehurst
Anne Thorne Whitford
James William Wicker, Jr.
Vanessa Louise Wicker
Samuel A. Wilen
Barbara Elaine Williams
Catherine P. Williams
Steven D. Williams
Daniel Willis
Frances Rebecca Wilson
James Oliver Wilson
James D. Winthrop
Grace Marie Witter
Louise Elizabeth Woltz
Lei-Wah Cheong Wong
John Charles Wood
Robert Remington Wood, Jr.
Susan E. Woodard
Thomas F. Woolley
William Alan Louis Worrell
Deborah Wright
Harry Buford Wright, Jr.
Scott Wesley Wright
Leslie Grainge Wrigley, Jr.
Patricia Gail Wuensch
Marion C. Wyers
Aleecia Audrey Young
King Ming Young
Richard Charles Youngken
Richard Mark Zapf
Kathleen Ann Zeni
Lawrence R. Zipf
Peter Kevin Zirkle

Bachelor of Science

Robert Louis Adams
Robert W. Ambrose
Jerry Stewart Apple
Glenn Steven Axelrod
Mary Edwina Baker
Sara Katherine Baker
Susan Ramona Baker
Robert Clark Ballard
Catherine Klee Bang
Kathy Jean Barbuti
Susan Belle Bastress
Robert Waid Beard
Thomas Lewis Beardsley
Lee Alexander Beatty
Mark Abbott Benedict
Carol Jean Bennetts
Sheilah Ann Bernard
Andrew Austin Biewener
Richmond Loring Blackstone
Kenneth Wayne Blumenthal
Lisa Diane Bolio
Susan Lynn Boonstra
William Miller Bostic
James Robert Bostwick, Jr.
Monica May Brennan
Willis Edmund Brown III
Alexander P. Butterfield Jr.
Asher Burton Carey III
Kim Alan Carmichael
Michael Lee Carson
Ralph Edward Carson
Jamie Frank Cerutti
Herbert Mark Chain
Dorothy Adaire Chambers
Malcolm L. Chaney
William Amdor Chantry Jr.
Philip Jucha Chapa
Timothy Stephen Chappars
Rhonda Susan Cohen
Robert Leon Cook
Michael L. Cooper
Richard Steven Cooper
George F. Corrent
Gregory Hannibal Crisp
Lisa Lund Dahm
Kathleen Daus
Donald Gene Detweiler
John Edwards Dewar
Rodney R. Dietert
David Harrison Dill
Kathryn P. Dillon
Rebecca Anne Dull
Janet Marjorie Dunbar
Thaddeus Leland Dunn
Candace Lesley Dyer
Peter Howe Dygert
William S. Easton, Jr.
Melissa J. Eddy
Zeno Lester Edwards
Judith Day Ellingwood
Robert Bailey Elwood, Jr.
Roger Allen Engebretson
James Ronald Eskew
Elizabeth Anne Estrada
Debra Jean Eveland
Marshall Lewis Fay
William Leonard Ferber
Philip David Fernsten
Winfield Stitt Fisher III
Sara Palmer Flower
James Kevin Foskett
Ellen McLean Freymeyer
John R. Fuechsel
Frank Joseph Gadusek
David James Gipe

Jeffrey Mershon Graves
Daniel Morris Greenberg
Jennet Carson Gregg
Alberto Grignolo
Deborah Groves
Kenneth A. Grumet
Charles Samuel Hamilton II
David W. Hannon
Wayne Lee Harper
Joe Lynn Harris
Vaude Smoot Harris III
Arthur M. Hendrix, Jr.
Thomas P. Howard
Randall Bryan Hudson
James Melville Hutchison, Jr.
Frank Ward Irvin, III
Mary Kathryn Izard
James Kevin Jackson
William James Jaffurs, Jr.
Dianne Marie Jardno
Catherine Sue Johnson
Mark G. Johnson
Kimberly Rae Kartman
Dorothy Davis Kee
Donald M. Keen
Ralph Spaulding Kerr
Janet Ophelia Kilby
Diane Christine Komodowski
Marci Jane Kramish
William Kilpatrick Lambie III
Christopher Patrick Larkin
Roy Benedict Laughlin, Jr.
Kenneth Mong Hung Lee
Donald Alan Leichter
William Lippitt Jr.
Deborah Sharon Litman
Orville Preston Lowrey
Emily Ray Lutken
Doren Louise Madey
William C. Malik
Louise Francesca Mango
Gary Alan Manko
John Jacob Marks
David S. Marsh
Edith Ann Cochran Marsh
David Robert Mauerhan
Susan J. May
Gail Elizabeth Swinger McCormick
Christopher Slack McCullough
Julia Elizabeth McMurray
Edward Paul McNamara
Mary Janice McNeely
Peter Treadwell Milnes
Keneth David Mindell
Sterling Arthur Minor
Guy Britton Mioton, Jr.
Sarah A. Moffitt
Marcia Lee Moore
Richard Foy Moorer
Karen Moroch
Bruce April Moyer
Marilyn Murphy
Lance A. Mynderse
Albert John W. Novak, Jr.
Warren Woodson Olds
Judith Ann Olsen
Thomas Howard O'Neill
Eric Alfred Oristian
Peter Scott Paine
Robert Stanley Parker
David Ernest Patton
Jane Ellen T. Paxton
Gary William Peer
Olga Elizabeth Pestana
Doris Ellen Pew
Dana Stuart Pfaff
Winston Allen Porter, Jr.
Steven Paul Pruce
James Lawrence Purdie
Barbara Lynn Rather
Kenneth Bernard Rhinehart
Karen Driver Rhoad
Randall Craig Rickard
Terry Don Ricks
Steven Forest Roark
Justin Theodore Roscoe
Carol G. Rose
Ronald Rovner
Diane Linda Rubin
William Maxwell Russell
Lawrence J. Ryan
Richard Young Saffir
William Clark St. Amant
Patricia Fae Salter
Jon A. Sanford
Gary Steven Schleiter
M. Lane Schmidt
Frederick John Seidler
Victor Balmer Shelburne III
Douglas Paul Sherman
Martha Gail Shumate
Diana R. Silimperi
Edith Lee Simpson
Richard Edward Smitherman
Paul Mathieu Smolen
Carol Denise Spellen
Jennifer Elaine Taylor
Robert William Thrailkill
Anthony Philip Tinari
Richard Treherne Tolley, Jr.
Barbara Anne Trimble
Lucy Ellen Tyrrell
Timothy Darby Van Epp
Joseph Gregory Varnadore
Douglas Patrick Walters
Douglas John Watson
Susan Lynn Watts
Sharon Emelia Wells
Timothy C. Wilcosky
John Grant Wilmer, Jr.
Paul Louis Wischow
Susan L. Wolff
Sau Fong Wong
Ellen Elizabeth Wright
Barbara Browning Wygal

Bachelor of Science in Engineering

Dwight Stuart Aston
Don Wilson Baldwin
Robert Keith Bisset
Thomas Morgan Blower
Richard Jack Bowers III
Wayne Harris Brooks
Clyde Rittenhouse Butler, Jr.
Denison Edward Byrne
Clayton Tucker Chase
Dale Edward Cheek
James Dean Collins
John Medford Cox
Scott Alan Crawford
William Rowland Davies
William James Ross Dunseath, Jr.
Richard Mountford Ely
Kenneth Joseph Fanfoni
Joseph Graham Fitzsimons III
Robert Edward Fraile
David Michael Franklin
John Albert Gibbons, Jr.
Jeffrey Jay Ginsburg
Gary Eugene Grotenhuis
Douglas Alan Hardy
Gary James Heady
Michael Philip Helms
Roger Allan Hoffman
Stephen Doyle Huffman
Robert Alan Hyde
Daniel Howard Jacobs
Richard Clark Johnson
Samuel Greg Joseph
William Marshall Kelley
James Donald Klein
Bruce Maurice Klitzman
James Edmund Krekorian
Carl Ernest Lehman, Jr.
Michael James Lozanoff
Robert Bowley Lucas
Ralph Alan Marshall
David M. Mautner
Capers Walter McDonald
Gary Douglas McLaughlin
Stephen James Montgomery
Donald Ray O'Neal
William Edwin Palin, Jr.
Robert Ira Pozner
Mark Warren Reinhardt
Otho B. Ross, III
Royden Pierre Saffores
Nicholas Henry Sherman
Michael G. Taylor
David E. Thomas

Philip Wayne Thor
Bruce Gordon Trowbridge
David Thomas Troyan
D. Mark Upham
Stephen A. Van Albert
John Stephen Veatch
Philip H. Vorsatz
Samuel S. Waters IV
Dennis George Wedgworth
Robert Dale Welch
Stephen Long Whiteside
Russell Lake Wildman II
John Erby Wilkinson
Steven Platt Williams
Frank H. Wilmot
Blake Shaw Wilson
Max TenEyck Woodbury
Karl Ray Woodruff
Ray Lee Wooten
George Steve Yanek, Jr.
Richard Krikor Yardumian

Bachelor of Science in Nursing

Joyce Nan Adler
Mary Scott Allen
Phoebe Edwards Bacon
Catherine Elizabeth Bain
Betsy Anne Behnke
Laurie Kristin Bing
Beverly Ann Bradley
Martha Elizabeth Brown
Leslie Buchanan
Cynthia Jones Buck
Clementine Lavonne Bullock
Mary P. Calhoun
Sandra Ann Campbell
Martha Talmadge Carey
Margaret Dickie Cartier
Mary-Alice Classen
Mary Ann Clayman
Susan Duté Compton
Joan O'Connor Corboy
Ellen Dee Cummings
Cynthia Irene Dahnk
Nancy Dearborn
Jacqueline Alice DeCola
Linda Sue Christman Dilgren
Christie Ann Dunn
Cynthia Jane Ervin
Beth Lynn Feidler
Susan Rose Finkle
Deborah Lee Fiori
Deborah Ann Foard
Carol Lynn Foster
Patricia Karen Furey
Nancy Elizabeth Geiger
Gwen Francine Hegyan
Christine Ann Hoelzel
Catherine Marie Jenkins
Laurie Ann Johnston
Judith Ann Jones
Valerie Kane
Janet Shepard Kinney
Ann Druheart Hatcher Kirk
Margaret Hanna Kreisle
Deborah Louise Kucher
Linda Jane LaPlante
Christina Heli Larnola
Susan Southard Lebo
Joan Kathleen Lehman
Ruth Ann Leight
Deirdre Irwin Lukoski
Nancy Elizabeth Marshall
Nancy Lee Marville
Barbara Ellen McAlpine
Dianna Jean McCartney
Marilyn Ray McGehee
Leslie Ann McWilliams
Jane Alden Mercer
Claudia Robertson Merritt
Deborah Jean Nearing
Jill Allison Oglesby
Anita Gineen Ord
Sally Margaret Pekora
Catherine Lee Piepmeier
Sherry Lynne Pogmore
Bonnie Lynn Reyle
Cathy Jean Richards
Cynthia Louise Richardson
Deborah Tregillus Sabin
Katherine Copeland Shelden
Pamela Love Smith
Robin Deming Specht
Cynthia Jane Stoudt
Anne Hopkins Terhune
Judy Childs Terriberry
Jill Elizabeth Tiffany
Margaret Sarah Tipping
Deborah Ford Umberger
Tamara Lynn Wardell
Deborah Jane Webb
Connie Dupler Willet
Robin Linke Wilson
Laura Lynn Zelaites
Lucinda Alice Zuck

HONORS AND DISTINCTIONS OF CANDIDATES FOR DEGREES, 1974

TRINITY COLLEGE OF ARTS AND SCIENCES

Summa cum laude

Michael Lee Gooper
Elizabeth Langsford Sears
Randall Craig Rickard
Susan Toy Andrews
Wendy Lynn Marshall
Janet Ophelia Kilby
Nancy Scott Becker
Stephen Walter Brewer
John Charles Wood
Richard Waldo Scott
Bruce Roger Genderson
Betsy Ellen Walker
James Marx Iseman, Jr.
Walter Russell Rogers, Jr.
David Ward Hannon
Barbara Anne Trimble
Morgan Paul Meyer
Jarvis Dean Brock
Sharon Sharp Andrews
Joanne Carol Shepard
Nels Robert Leininger
Ronald Rovner
Doren Louise Madey
Cornelia Kip Walker
Ellen Elizabeth Wright
Donald Frank Hull, III
Amy Dale Hogue
John Edwards Dewar
Jerry Stewart Apple
Clark Anderson Ward
William Clark St. Amant
Melville Stewart Brown
Warren Woodson Olds
Margaret Susan Allison
Deborah Lea Byrd
David Clarence Morris
Deborah Groves
Daniel Morris Greenberg
Bruce April Moyer
Emily Ray Lutken
James Ronald Eskew
Kenneth Allen Shifrin
Lida Rogers Hall
James S. Peter Beck, III
Thomas Lewis Beardsley
Steven Robert Savona
Joseph Owen Gehrett, Jr.
Philip Joseph Butera
David Mark Eisenberg
Christina Hall
Katherine Hardison Lamb
Richard Painter Shryock
James Douglas Winthrop
Daniel Allen Rogers

Magna cum laude

Judith Mapes Lyman
Peter Kevin Zirkle
Virginia Faye White Roark
Steven Michael Klebanoff
Stephen Arnold Wank
Robert Norman Knight, Jr.
Madison Stockton Spach, Jr.
Richard Lewis Eisenberg
Steven Forest Roark
Michael Tad Hippler
Kathleen Marie Hanigan
Katherine Porcher Lockhart
Lawrence Morel Jones
Helen Andrews Winifred Smith
Sara Elizabeth Via
James Anthony Grasso, Jr.
Caroline Lucile Cook
Thomas Willard Robisheaux
Joan Bernadette Golden
Dana Stuart Pfaff
Orville Roy Surla
Alvin Harold Shrago
Nathan Lee Dodson
Sharon Jane Darragh
William Bernice Bunn, III
Diana Regina Silimperi
Helga Lura Leftwich
John Joseph Stocker
Thaddeus Leland Dunn
William H. Pauley, III
Allison Jean Krahling
Rebecca Anne Dull
Thomas Blumeyer Weaver
Marsha Lynn Van Lawick
Christine Adele Schoenberg
Lucille Ann Dibello
John Stephen Hahn
John Lockwood Walker
David Franklin Smith
Martha Louise Elks
Jerome Robert Smith
Donald Walter Reneau
Gail Dian Goundry
Sara Palmer Flower
Donald McGee Etheridge, Jr.
Joseph Gregory Varnadore
Barbara Ann Buzun
Julie Ellen Blume
Roberta Ellen Pearson
Robert Thrailkill
Susan Belle Bastress
Gail Lynn Unterberger
Justin Theodore Roscoe
Edward Steven Lauer
Linda A. Usdin
Shawn Lunney Kelly
Wayne Richard Kempson
Richard Jon Welch
Victoria Jane Fleming
Richard Edward Smitherman
Victor Balmer Shelburne, III
Randall Bryan Hudson
Mary Vincent Glennon
Wendy Karen Miller
Lawrence David Kaplan
Phyllis Anne Decarlo
Denise Aline Mummert
Anne Rouse Edwards
Margaret Lynn Norsworthy
Andrew Austin Biewener
Roddey Reid, III
Susan Alice Jones
Susan Ramona Baker
Jennifer Elaine Taylor
Louise Gordon Upchurch
Janet Roberta Beck
Richard Thorne Hurt
Rachel Love Steele
Robert Bruce Johnson
Thomas Peter Howard
Gilbert Julius Genn
Henry P. Nathan
Janet Anne Colm
Steven Richard Fletcher
Judith Lynn Rose Sacks
Anton Peter Nielsen
John Wesley Clower
Charles Michael Vanderhorst
Nancy Ann Powers
Donald Gene Detweiler
Gwen Michelle Enfield
Hazel May Hartsoe
Cheryl Anne Rouge
Beverly Harper Means
Laurie Virginia Stauffer
David Beryl Rubin
Thomas Gordon Hoffman
Jesse Michael Colvin
William Leonard Ferber
John Robert Fuechsel
Robert Charles Barrett
Rodney Reynolds Dietert
James Monroe Avent
Lucy Ellen Tyrrell
Mei-Ku Huang
Susan Haltiwanger
John Everett Gent
Sharon Emelia Wells
Nancy Ann Palmer
Robert Alan Jarrow
Jane Alethia Hewitt Berlin
Thornton Sidney Smith
Joseph Allen Boone
Ellen Dabney McLean Freymeyer
Nancy Jeanne Muller
Gordon Eugene Stanley
James Gordon Philipson
Martha Ann Shindelman Noe
Holly Elizabeth Hoffman
Marsha Jean Kuhn
Joel Steven Goldberg
Craig Arnold Updegrove
Gary Steven Scheiter
Carol Grammer Rose
Roberdeau Dunn Simmons
David Barry Stein
Deidra Margaret Patton
Deborah Jeanne Brooks
Robert Richard Kuehn
Kathleen Barlow Morgan
Patricia Winslow Emlet
Robert Francis Bencze
Daniel Patrick McMahon
James William Wicker, Jr.
Paul Joseph Mass
Kenneth Alexander Black
Deborah Lynne Struchen
Milton William Frenzel
Alice Louise Kirkman
Louise Linda Martorelli
Elizabeth Marie Brunner Hall
King Ming Young
Douglas Paul Sherman
Robert Walter Ambrose, Jr.
Susan Lynn Fetter
Mark Raymond Walling
Dennis Richard La Fiura
James Lanauze Hill
Kenneth Patrick Kirk
Barbra Knowlton Fite
James Lee Morris
Kathleen Daus
Mark Abbott Benedict
Martha Jane Elson
Stephen Ian Reinstein
Alfred Owen Peeler
Patrick Thomas Crane
Ellen Joan Tchorni
Thomas Edward Dittmar
Clifford Howard Nelson, Jr.
Jane Elizabeth Shaw
Julie Wilson Jetton
Gayle Beth Grossman
William Robert Clarke
Marjorie Ruth Becker
Nancy Knight Duggins
Michele Portman Barragan
Kenneth Bernard Rhinehart
Lance Edward Tunick
David Murray Jeuda
Charles Eric Mortensen
Barbara Browning Wygal
Paul Louis Wischow
Eric Frank Ensor
Janet Marjorie Dunbar
John Martin Robinson
Judith Ann Migliori
Jane Castor Albertson
Bruce Mark Albert
Kathryn Jean Mann
Peter Howe Dygert
Candace Marie Johnson
Deborah Kaye Roberts
Lee Garner Gersch
James Lewis Moore
Susan Lynn Watts
Lee Alexander Beatty
Sarah Elizabeth Moran
Arthur Montgomery Hendrix
Laurie Ivins

Jon Julian Harrison
Patricia Mary Percival Hughes
Christopher Barcroft Graybill
Michael Severns Baker
Ronald Evan Barab
Mark Reid Howard
Lynn Paula Mathieu
Richard James Fildes
Gregory Norman Smith
Julie Roberta Adie
Craig Scott Dillman
Debra Lynn Kasper
Anna Beth Payne
Jo Ann Farrington
John Thomas Cheek
Jeffrey Carter Tyler
Rose Marie Motley
Carla Ann Neeley
Charles Gilbert Cofer
Stephen Russell Lewis
Barbara Hall Hoover
William Arthur Kennedy
Denise Gay Scott
Lawrence J. Ryan
Michael David Calhoun
Alberto Grignolo
Jean Elizabeth Haworth
Robert Benson Euler
Bonnie Katherine Parr
Mary Melinda Malik
Julia Elizabeth McMurray
Christopher Slack McCullough
Thomas William Weaver
Deborah Holcomb Smith
Adam Sternberg
Robert Stanley Parker
Larry Joe Morell
Michael James Breen
Richard Steven Cooper
Larry Marc Segall
Stephen Gary Melcer
Mary Janice McNeely
Samuel Aurelius Owen, Jr.
David Clinton Crago
Kim Alan Carmichael
Alison Mills Gardner
Carolyn Annette Prescott
Ellen Margaret Thompson
Emily Jean Averill
Orvey Preston Lowrey, III
Herbert Roland Stender, III
Dianne Marie Jardno
Paul Mathieu Smolen
Timothy Michael Murray
Eric Alfred Oristian
Christian Edward Paletta
Philip Allan Disque
Betty Lynn Parker
Ben Cox Garrett
Margaret Anne Spigener
Michael Stuart Ives
Marc Harry Dawson
Frances Patricia Papa
Richard Treherne Tolley, Jr.
Sara Kathryn Sudduth
Susan Lee Wolff
Melissa Jane Eddy
Richmond Loring Blackstone, Jr.
Stephen Henry Kupperman
Kerrie Lynn Protsman
Albert John Wittmayer Novak, Jr.
William Gavin Scott, III
Allison Armstrong Blount
Elizabeth Ann Brahana
Walter Earle Fowler
Debra Susan Scherner
Ann Exley
Michael Sobeloff Mayer
Diane Leigh Appleton
Bruce Chambers Stevens

Departmental Graduation with Distinction

Art

Elizabeth Langsford Sears
Helen Winifred Smith

Botany

James Melville Hutchison, Jr.

Chemistry

Robert Francis Bencze
Michael L. Cooper
Donald Frank Hull III
Bruce April Moyer
Thomas Howard O'Neill
Randall Craig Rickard
Margery Sue Sved
Robert William Thrailkill
Barbara Anne Trimble

Economics

Fred Raymond Butner
Michael David Calhoun
Patrick Thomas Crane
David M. English
Bruce R. Genderson
Michael Stuart Ives
Wendy Lynn Marshall

English

Joseph Allen Boone
John Wesley Clower
Anne Rouse Edwards
Jo Ann Farrington
Amy Dale Hogue
Paula Beth Newman
Daniel Allen Rogers
David Franklin Smith

Germanic Languages and Literature

David J. Ward

History

David Clinton Crago
Lee G. Gersch
Michael Sobeloff Mayer
Donald Walter Reneau
Harold E. Stine, Jr.

Music

Emily Jean Averill
Denise Aline Mummert

Political Science

Michael S. Baker
Donald McGee Etheridge, Jr.
Jonathan G. Jacobson
Shawn Lunney Kelly
Dennis R. La Fiura
Roberta Ellen Pearson
John Joseph Stocker

Psychology

John Marshall Alton
Sara Katherine Baker
Fred Boyd Bryant II
Michael Lee Carson
Janet Marjorie Dunbar
Melissa J. Eddy
Richard James Fildes
Andrea Kanon Frey
Frank Joseph Gadusek
Alberto Grignolo
Christina Hall
Joe Lynn Harris
Dianne Marie Jardno
Larry Allen Kubal
Marie Therese Lee
Doren Louise Madey
David S. Marsh
Edith Ann Cochran Marsh
Neil Stanley Newhouse
Karen Driver Rhoad
Anthony Philip Tinari
Gail Lynn Unterberger
Craig Arnold Updegrove

Public Policy Studies

David Beryl Rubin

Romance Languages

Patricio Gutierrez

Slavic Languages and Literature

Julie Ellen Blume

Sociology

Damon Louise Elster

Zoology

Susan Ramona Baker
Rodney R. Dietert
Craig Michael Feeney
Thomas Gordon Hoffman
Edith Ann Cochran Marsh

AIR FORCE RESERVE OFFICERS TRAINING CORPS

Distinguished Graduates

Diane Christine Komodowski
Robert John Schmidt

SCHOOL OF ENGINEERING

Summa cum laude

Bruce Gordon Trowbridge
Carl Ernest Lehman, Jr.
Stephen Long Whiteside
James Donald Klein
Michael G. Taylor

Magna cum laude

Ray Lee Wooten
Gary Douglas McLaughlin
Ralph Alan Marshall
Robert Keith Bisset
Mark Warren Reinhardt
Capers Walter McDonald
Nicholas Henry Sherman
Philip Wayne Thor
William James Ross Dunseath, Jr.
David E. Thomas
Otho B. Ross, III

Departmental Graduation with Distinction

Civil Engineering

Mark Warren Reinhardt

Electrical Engineering

Ralph Alan Marshall
Otho B. Ross, III

Mechanical Engineering

Michael Philip Helms
Carl Ernest Lehman, Jr.
Philip Wayne Thor

Elections to Tau Beta Pi

James Donald Klein
Carl Ernest Lehman, Jr.
Ralph Alan Marshall
Capers Walter McDonald
Gary Douglas McLaughlin
Mark Warren Reinhardt
Nicholas Henry Sherman
Michael G. Taylor
David E. Thomas
Philip Wayne Thor
Bruce Gordon Trowbridge
Stephen Long Whiteside
Ray Lee Wooten

SCHOOL OF NURSING

Summa cum laude

Nancy Lee Marville
Deborah Jean Nearing
Martha Elizabeth Brown

Magna cum laude

Sandra Ann Campbell
Gwen Francine Hegyan
Ann Druheart Hatcher Kirk
Ellen Dee Cummings
Cynthia Irene Dahnk
Patricia Karen Furey
Deborah Ford Umberger
Mary Scott Allen
Leslie Buchanan
Joan O'Conor Corboy
Deborah Ann Foard
Nancy Elizabeth Geiger
Barbara Ellen McAlpine
Dianna Jean McCartney
Sally Margaret Pekora
Margaret Sarah Tipping
Mary Ann Clayman
Deborah Lee Fiori
Judith Ann Jones
Joan Kathleen Lehman
Nancy Elizabeth Marshall
Anita Gineen Ord
Cynthia Jane Stoudt
Connie Dupler Willet
Laura Lynn Zelaites

ELECTION TO PHI BETA KAPPA FROM THE CLASS OF 1974

Susan Toy Andrews
Jerry Stewart Apple
James S. Peter Beck III
Julie Ellen Blume
Stephen Walter Brewer
Jarvis Dean Brock
Melville Stewart Brown
William Bernice Bunn III
Sharon Jane Darragh
John Edwards Dewar
Nathan Lee Dodson
Thaddeus Leland Dunn
Anne Rouse Edwards
David Mark Eisenberg
James Ronald Eskew
Joseph Owen Gehrett, Jr.
Bruce Roger Genderson
James Anthony Grasso, Jr.
Daniel Morris Greenberg
Deborah Groves
Christina Hall
Lida Rogers Hall
Kathleen Marie Hanigan
David Ward Hannon
Amy Dale Hogue
Donald Frank Hull III
James Marx Iseman, Jr.
Janet Ophelia Kilby
Steven Michael Klebanoff
James Donald Klein
Katherine Hardison Lamb
Carl Ernest Lehman, Jr.
Nels Robert Leininger
Emily Ray Lutken
Judith Mapes Lyman
Gary Douglas McLaughlin
Doren Louise Madey
Morgan Paul Meyer
Edmund Dandridge Milan, Jr.
David Clarence Morris
Bruce April Moyer
Warren Woodson Olds
Randall Craig Rickard
Steven Forest Roark
Virginia Faye White Roark
Walter Russell Rogers, Jr.
Ronald Rovner
William Clark St. Amant
Steven Robert Savona
Joanne Carol Shepherd
Kenneth Allen Shifrin
Richard Painter Shryock
Diana Regina Silimperi
Helen Andrews Winifred Smith
Richard Edward Smitherman
Michael Gary Taylor
Barbara Anne Trimble
Bruce Gordon Trowbridge
Marsha Lynn van Lawick
Joseph Gregory Varnadore
Stephen Arnold Wank
Clark Anderson Ward
Stephen Long Whiteside
James Douglas Winthrop
John Charles Wood
Ray Lee Wooten
Ellen Elizabeth Wright

SPECIAL PRIZES AND AWARDS

ACC Plaque for Excellence in Scholarship and Athletics—Steven Wheeler
American Chemical Society Award in Analytical Chemistry—Barbara Anne Trimble
American Public Works Association Prize—Michael Gary Taylor
American Society of Civil Engineering Prize—Robert Alan Hyde, James Franklin McAlister, Jr.
Alice M. Baldwin Scholarship Award—Janet Roberta Beck, Julie Ellen Blume, Barbara Ann Buzun, Martha Jane Elson, Doren Louise Madey, Sarah Elizabeth Moran, Carol G. Rose, Diana R. Silimperi, Carol Denise Spellen
Evelyn Barnes Memorial Scholarship—Ellen Margaret Thompson
Julia Dale Prize in Mathematics—First Prize—Jarvis Dean Brock
Angier B. Duke Memorial Scholarship Award—Mary Scott Allen, Margaret Susan Allison, Susan Ramona Baker, Robert Francis Bencze, Bruce Frederick Blakely, William Bernice Bunn, III, Janet Anne Colm, Barbara Jane Deal, Joan Bernadette Golden, Daniel Morris Greenberg, Vaude

Smoot Harris III, Donald Frank Hull III, Robert William Johnston, Marci Jane Kramish, Capers Walter McDonald, Daniel Allen Rogers, Barbara Anne Trimble, Stephen Long Whiteside, John Charles Wood

Duke University Department of Chemistry Award—Michael L. Cooper, Randall Craig Rickard
Anne Flexner Memorial Award for Creative Writing—Second Prize—David Alan Stirling
Raymond C. Gaugler Award in Materials Science and Engineering—Stephen Long Whiteside
Theodore C. Heyward Pi Tau Sigma Award—Philip Wayne Thor
Edward C. Horn Memorial Prize for Excellence in Zoology—Sara Elizabeth Via
William T. Laprade Prize in History—Donald Walter Reneau
Merck Index Award—Donald Frank Hull III, Stephen Arnold Wank
Milmow Prize—Otho B. Ross, III
Moseley Award—Nancy Lee Marville
School of Nursing Alumnae Award—Nancy Lee Marville
James A. Oliver Memorial Award—Melville Stewart Brown, Kenneth A. Shifrin
Panhellenic Scholarship—Elizabeth Anne Estrada
Charles Ernest Seager Memorial Award—Ralph Alan Marshall
Walter J. Seeley Scholastic Excellence Award—Bruce Gordon Trowbridge
William Senhauser Prize—Larry Marc Segall
George Sherrard III Memorial Award in Electrical Engineering—Bruce Gordon Trowbridge
Woman's College Memorial Scholarship—Virginia Rutlege Forney, Carol Denise Spellen
Karl E. Zener Award—Karen Driver Rhoad

DEGREES AWARDED SINCE THE PREVIOUS ANNUAL COMMENCEMENT DIPLOMAS DATED SEPTEMBER 1, 1973

BACHELOR OF ARTS

Dianne Rodgers Agner
Karen R. Appy
Todd S. Auryansen
James Larry Baker
Mary Louise Beede Bates
Samuel William Bearman
Melinda Allen Beck
Leslie Beckenbach
Robert James Beckman Jr.
Donnel Isadore Bell
Thomas Craig Brodsky
Jeffery Howard Browning
Fred Raymond Butner
Barbara Lee Cence
Frederick Lee Cornnell, Jr
Robert Cordes Crawford
Jerry Carl Currin
James C. Donald
Susan Rae Donnalley
Barbara A. Gaither
Margaret Gentry
Mary Celestea Byrd Gentry
Frederick Bioren Getze
Herma Rika Goldman
Frank Douglas Gray
Howard Gray, Jr.
Nora Gunneng
Lynn Hagel
Ruthann Huling Hall
Christine Anne Hatfield
James Robert High, Jr.
Arthur Glenn Holder
Gregory Dean Hughes
Nancy Gilchrist Johnson
Wendy Anne Keitel
Bryan Charles Kempter
John Edward Kimura
Antoinette R. Kramer
Elizabeth Ann Kyle
Millard F. Mann
Rudolph J. Martineck
Jeremy Ian David McLean
John Andrew Miller
William Howard Miller
Scott Joel Milzer
Cassandra Felecia Newkirk
Walter Keith Nye
Margaret Anne O'Connell
Elva Merry Pawle
Pamela Marcia Pollack
Walter Alvin Record III
Robert Emerson Rice
Douglas Guy Scrivner
Willis Howard Slane III
John Alfred Snead
James Andrew Zellinger

BACHELOR OF SCIENCE

Adour G. Adrouny
Richard Barratt Allen
Peter Baker
Carl Norman Bronner
Pamela Cotton
Bennett Weil Garner
Cathy Denise Harbison
Michael John Hayes
Thomas Raymond Hicks
G. Maret Maxwell
James Michael McKinney
David McIver Millsaps
George E. Sanderson
Scott Edward Setesak
Cheryl Sue Strober
Robert Gordon Tague, Jr.
Katherine Anne Twombly
Judith Jansen Wallis
Mary Clarke White

BACHELOR OF SCIENCE IN ENGINEERING

Edward Richard Harback

CLASS HONORS

TRINITY COLLEGE OF ARTS AND SCIENCES

Freshmen Class Honors 1973-1974

Adams, Margaret L.
Ambroze, Christopher
Anders, Gretchen E.
Anderson, Roger F., Jr.
Ansel, Craig A.
Barlow, Pamela J.

Barnes, Jane D.
Barrett, Laura E.
Bednar, Mary
Begandy, Mark K.
Behr, Jeffrey T.
Benton, Kristina
Bernstein, Marc A.
Blacker, Elysa Joy
Blaha, Charles O.
Brantley, Dorothy Alison
Brasher, Bruce
Brister, Scott A.
Bromberg, Burt I.
Brown, Robert G.
Burke, Marianne C.
Byers, Frederick
Calem, Paul S.
Calvert, Richard J.
Campanella, Stephen D.
Campbell, Elizabeth A.
Campbell, Maxwell G.
Carew, Kathleen A.
Cargile, John S. III
Cash, Lester D.
Cheek, Virginia I.
Clayton, David F.
Cohen, Gary I.
Conway, Bradley L.
Coukos, Joan E.
Cowgill, George B.
Coyle, Kathleen M.
Craig, Robert B.
Danello, John J.
Darcey, Michelle G.
Davis, Brian T.
Davis, Clinton B. II
Davis, Delta A.
Davis, James W., Jr.
Dawson, Sara Lynn
Day, Eugene D., Jr.
Dean, Richard L. II
Dehaas, Betsy Rene
Dein, John R.
Dennis, Steven H.
Doniger, Ken J.
Driscoll, Patrick G.
Dul, Jeanne L.
Dunaway, M. Tray
Eby, Charles S.
Edgerton, Mary A.
Edmondson, Guy M.
Eisinger, Howard F.
Engels, Thomas
Erlick, James M.
Eshleman, Michael J.
Evershade, Elsa
Falkner, Melissa K.
Farrell, Jean F.
Feinman, David S.
Feldman, Marc D.
Feldman, Peter M.
Fetchick, Richard J.
Finestone, Sally R.
Fischer, Philip T.
Freeman, Theodore M.
Fuchs, Wesley K.
Fudman, Edward J.
Gallagher, Carole L.
Gallalee, John A.
Gallimore, Kim W.
Gellman, Judith
Gilliand, Mark H.
Ginsburg, Amy L.
Gittin, Robert G.
Glickman, Ronnie C.
Goldenhersh, Lawrence E.
Graumlich, James F.
Greenberg, Lewis
Grigg, Phillip J.
Guyon, Janet L.
Gwyn, Mary L.
Haas, Mark
Hammett, John S.
Hamrick, Michael D.
Hankins, James W.
Hanway, Susan King
Harris, Wesley J.
Hayes, Dale A.
Heckert, Richard R.
Hege, Christian D.
Henking, Susan E.
Henschel, Holly E.
Henshaw, Georgeanne
Hibbard, Gerri L.
Higgins, John B., Jr.
Hodskins, Roger A.
Hoffman, Bruce W.
Hoffman, Edwin L.
Hoffman, Stephen A.
Hoffmann, Diane E.
Holden, Hazel M.
Holloway, James A.
Holmes, Janet A.
Holt, Curtis A.
Hoop, Elizabeth L.
Horne, Patricia S.
Hovde, Steven D.
Humphries, John J.
Hutchison, Elizabeth W.
Ierardi, James P.
Jacobs, Martin P.
Jeter, Robert V., Jr.
Jolly, William A.
Jones, Claudia K.
Kapell, Elisa A.
Kaplan, Marilyn R.
Karukstis, Kerry K.
Katzenstein, Lisa A.
Keyser, Gregory M.
Kleist, Paul C.
Konigsburg, Paul
Krasnoff, Jeffrey P.
Kreit, John William
Kremers, Peter W.
Kress, Kenneth R.
Lallier, Charles W.
Lambert, Douglas Paul
Lamm, Linda E.
Larson, Susan C.
Lee, Mary A.
Lee, Victor C.
Leiman, Daniel H.
Leppert, Timothy J.
Lifson, Nancy L.
Lindblad, Robert W.
Liscow, David M.
Loftin, Laura A.
Loprete, Kimberly A.
Loring, Elaine S.
Lottich, Susan C.
MacFarlane, Charles S.
Man, Thomas H.
Manzer, David S.
Margolis, Jeffrey I.
Mason, Pamela A.
Matthews, James A.
Matthews, Melodie C.
Maunsell, John R.
Mayer, Olivia A.
McCafferty, Kevin A.
McNeill, David C.
Meador, Steven A.
Meeker, Suzanne E.
Meese, Roderick B.
Mendel, Peter A.
Menzel, Charles R.
Merritt, Craig T.
Metz, Richard I.
Middleton, Elizabeth A.
Miller, Mark D.
Miller, Peter M.
Mills, Peter H.
Mitchell, William H., Jr.
Morrison, Robert R. III
Muench, Marjorie R.
Murphy, Brenda K.
Nason, Peter S.
Newton, George B.
Nicolaides, David B.
Nielander, Thomas P.
O'Donnell, William E.
Pagliuca, Stephen G.
Park, Edwards A.
Parker, Barry D.
Patton, Rebecca L.
Phillips, Gary L.
Poyet, Patricia A.
Prak, Mark J.
Prosser, Rex M.
Putnam, William S.
Quaritius, Jeffrey H.
Randall, Ruth A.
Rehr, Linda J.
Riegel, Edward M.
Roberts, Lawrence H.
Rocap, Donald E.
Rode, Sandra L.
Roe, Brian D.
Romney, Rebecca
Rosen, Randy A.
Rosenfeld, Jane S.
Rowland, Mary Merle
Royce, Richard D., Jr.
Rubenstein, Richard M.
Rudd, Carolyn Reeves

Sackett, Margaret B.
Saleeby, David E.
Sand, Irving D.
Satre, Steven P.
Schafhausen, James M.
Schroeder, Mark S.
Schwartz, Steve Wendelin
Scolaro, Cara A.
Sealy, Thomas R. III
Sears, Barbara E.
Secrest, William J.
Segal, Teddy D.
Shabb, William A.
Shappert, Gretchen C.
Sherman, David J.
Sherman, Stuart A.
Sipe, Mark C.
Smith, Anne E.
Sords, Kathryn Lynn
Sourbeer, Jeffrey J.
Sparks, Donna L.
Stanley, Thomas B. III
Steer, Deborah S.
Stelson, James M.
Stern, Carol A.
Stern, Steven D.
Stewart, David S.
Stiner, Allan E., Jr.
Stoneberger, Frances L.
Stout, Virginia D.
Straughan, Baird D.
Stuck, William W.
Susac, Theodore J. II
Tanzer, Kim M.
Taylor, George S.
Thienemann, Margo L.
Thomas, Karen
Tobias, Michele A.
Tremoulet, Andree M.
Trent, Ava M.
Trevaskis, David K.
Umbach, Corwin P.
Vaughan, Kenward S.
Valasquez, Patti A.
Vorona, Robert D.
Walberg, Janet L.
Warnock, Robert H., Jr.
Weaver, Patricia M.
Weider, Alan W.
Weiman, Andrew L., Jr.
Weinberg, Alan C.
Weinberger, Richard F.
White, Elizabeth Emory
Williams, Reden R. III
Wilmer, Herbert S.
Wilson, Barbara J.
Wolf, Eve M.
Yarborough, John M.
Young, Robert B.
Yousem, Samuel A.
Zastrow, Mary E.
Zipp, Frederick S.

Sophomore Class Honors 1973-1974

Aguilar, Manuel O.
Ahmann, Sarah W.
Allen, Craig S.
Aller, Cynthia L.
Allman, Teena L.
Ammerman, Alice S.
Amos, Paul D.
Anderson, Jeffrey P.
Andrews, William C., Jr.
Armaly, Raya
Ashcraft, William R. III
Atkins, Bowman K.
Ayrer, Michael J.
Baier, Laurie Anita
Baker, Laura E.
Barnes, Theresa G.
Batlle, Juan F.
Bazemore, Webster C. Jr.
Beacham, Robert E.
Bechtel, Pamela B.
Beissinger, Mark R.
Bell, Margaret Johnson
Bergen, Elizabeth B.
Bickel, Beverly A.
Boenecke, Clayton A.
Bosse, Richard C., Jr.
Bostian, Michael D.
Bowers, Carole E.
Brandon, D. Rhett
Brandon, John D.
Brehm, Barbara A.
Breslow, Marc I.
Broderick, Kathryn P.
Browder, Diane M.
Brown, Paul G.
Brunstad, William D.
Bryan, Thomas M., III
Burtis, Cleo F.
Calhoun, Lee A.
Campbell, Elizabeth E.
Campbell, Terence D.
Cannon, Cynthia F.
Cantrell, Keith W.
Carlton, Douglas D.
Carmichael, Claude R.
Caudill, James W.
Cavanaugh, Patricia J.
Ceperley, Laura E.
Chandler, Dalby R.
Chirichella, Eric J.
Christenberry, Rebecca E.
Christianson, Cuyler P.
Church, George M.
Clark, Janice L.
Clark, Martha A.
Clemens, Judith L.
Cohen, Alvin M.
Cohen, Howard J.
Cohen, Stephen D.
Coleman, Gail
Coletta, Corinne A.
Conner, Laurie C.
Costlow, Jane T.
Cox, Catherine C.
Cox, William R.
Crisara, Stephanie N.
Croft, Thomas A.
Cross, David B.
Cross, Susan J.
Crow, Wayne H.
Cutlip, Donald E.
Daly, Gerald C.
Daniel, Cristin A.
Daniel, Thomas F.
Dannehl, Karl N.
Danziger, Robert S.
Davies, William D.
Davis, Brooke H.
Davis, Charles K.
Davis, Lant B.
Davis, William Raymond
Dennard, David T.
Denning, Stephen M.
Dietrich, Dennis W.
Dockry, Kathleen A.
Donnell, Sally L.
Dowd, Sally C.
Doyle, William J., III
Dozier, Mary G.
Dozier, Robert E.
Dugoni, James E.
Duncas, Margaret A.
Dunn, Mitchell B.
Dykers, Patricia I.
Eacho, William C., III
Edwards, Deborah
Eidson, John R.
Emery, Daryl C.
English, Karen A.
Ewing, Gilmer C.
Fairchild, Ann V.
Falvello, Lawrence R.
Farris, Fred S.
Faulkner, Lillian J.
Feltman, Douglas S.
Fick, Duncan D.
Fluck, Brian H.
Forrest, Kathleen
Foster, Thomas S.
Fraysse, Mary J.
Froemming, Mark D.
Gallaher, David N.
Gardner, Gay L.
Geist, Gordon E.
Giesecke, Stephan A
Giguere, Jeffrey K.
Gofreed, Deborah L.
Golieb, John A.
Gombar, Greg A.
Gore, Thomas B.
Gray, Michael K.
Grigsby, Carol A.
Griscti, Robert S.
Haigh, Robert William, Jr.
Harman, Marsaleete
Harper, Robert T.

Hassman, Mark F.
Hazen, Kenneth R.
Healy, Patrick K.
Hegyan, Marla C.
Henderson, Robert E.
Higgins, Mary M.
Hinson, Winifred H.
Hittman, Mark H.
Hoff, Robert D.
Hoffman, Wayne K.
Hollar, Dale E.
Holloman, Ann D.
Holzsweig, Sarah F.
Howell, David N.
Huang, Mei-Chien
Huie, Wade P., III
Hull, Louise H.
Hunter, Nancy H.
Hurt, George S., III
Jackson, Gary W.
Jacobi, Maryann
Jakus, Lawrence K.
James, Clare A.
James, Georgeanne P.
Johnson, Catherine S.
Jones, Evangeline C.
Kahana, Madelyn D.
Kalavritinos, Christina S.
Kaltenborn, Konrad C.
Kapmick, David J.
Karampelas, Dean T.
Kartman, Marc G.
Katzin, David N.
Keesler, Lenoir C., Jr.
Kennedy, Deborah D.
Keyserling, Thomas C.
Kingery, David R.
Klemfuss, Rosemary M.
Kopenhefer, Richard W.
Krister, Laura E.
Krohn, Steven A.
Kronenberg, James M.
Kuhn, Michael K.
Kunkle, Kim
Labazee, Christiane A.
Lake, Emilie C.
Lambert, Robert A.
Landry, Donna E.
Lane, Richard A.
Latham, Robert A., III
Leas, Michael R.
Leblon, Annette M.
Lockhart, Thomas P.
Long, Isabella P.
Lucas, Kathryn J.
Luck, Stephen B.
Lupo, David E.
Mackowski, John M.
Manis, Mark W.
Manning, Scott C.
Mappin, Francis G.
Marfing, Thomas E. Jr.
Marquess, William H.
Marshall, Carolyn
Martin, James I.
Masters, Sarah K.
Matloff, Jody L.
Matthews, Charles J.
Mende, Susan E.
Meyer, Robert B.
Mintzer, Richard E.
Mitchell, Julia C.
Montgomery, David Arthur
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Moore, James E.
Morrill, Margaret C.
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Motsinger, Mark B.
Mow, Deborah S.
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Myers, Elizabeth R.
McCall, Mary Jane
McCann, Carrie A.
McGuigan, Leigh A.
Nunn, Chalmers M. Jr.
Olson, Christine A.
O'Neill, Kenneth J.
O'Toole, Neil M.
Owens, Michael A.
Paris, Timothy J.
Park, Grace M.
Parker, Margaret E.
Parrott, Susan P.
Parsley, Lawrence J., Jr.
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Perretti, Peter N. III
Peterson, Laura E.
Pierce, Donald L.
Prasse, Jane E.
Prey, William T.
Price, Robert H., Jr.
Proctor, Edward S.
Ragland, Elizabeth
Rathlev, Niels
Ratliff, W. Mitchell
Reback, Richard N.
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Richard, Mark A.
Robertson, Daryl B.
Rodine, Mary K.
Rogozinski, Abraham
Roper, Edith D.
Rumer, Richard R.
Ruprecht, Robert R.
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Ryan, Jane M.
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Scott, Sylvia Ann
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Sellers, Patricia
Shea, Shawn C.
Shehee, Susan E.
Sheridan, Sue D.
Shields, John H.
Sides, Pamela D.
Silsby, Liana C.
Sims, Mary A.
Sindelar, Mark Barrett
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Spiegel, David M.
Stanley, Wilma E.
Steenbarger, Brett N.
Strickland, Susan E.
Sturm, Lynne
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Tapp, Robert J.
Taylor, Kenneth M., Jr.
Thompson, Catherine E.
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Throckmorton, C. W., IV
Timby, Patricia A.
Tompert, James E.
Towers, Susan S.
Trover, Marguerite H.
Turner, James L.
Van Dalen, Robert W.
Walker, Derek A.
Walker, Elizabeth R.
Walker, Nan D.
Walters, Linda Lee
Waters, Leslie E.
Wegwart, Gordon T.
Welch, Sally R.
Werley, Elizabeth L.
Whatley, Nancy E.
White, Alexandra D.
White, Kathleen M.
White, Thomas R.
Wight, Jonathan B.
Wilbanks, John W.
Wilkinson, Sarah E.
Williams, Andrew C.
Williams, Marna B.
Wilson, Marla D.
Wochos, Frank S.
Wood, Jeffrey L.
Wood, Margaret W.
Yarbrough, Emily E.
Yensen, Kathryn D.
Zechiel, Janet C.
Zell, Brian K.

Junior Class Honors 1973-1974

Abriss, Richard B.
Adams, Marsha G.
Allen, Lyle M. III
Allen, Patricia A.
Amedeo, Ralph M.
Ames, Elizabeth W.
Anderson, William A.
Atwood, Donna M.
Avery, G. Randall

Baker, Merl W.
Barnett, Leecy A.
Barr, George B., Jr.
Barrett, William C.
Barrows, Albert A. III
Baum, Rudy M.
Baxter, William A.
Bender, Robert L. II
Benson, Louisa J.
Besch, Deborah J.
Bettini, Wanda J.
Brid, Janice L.
Blanchard, James E.
Blass, Jeffrey D.
Blei, Francine
Blount, Barbara M.
Boggs, Randall B.
Bohl, Marilyn Anne
Bohn, Ralt W.
Bond, Sheryl H.
Bonds, Mark E.
Bowman, Zebulon L.
Boyd, Darrell F.
Bradfield, Wendy L.
Bradley, Stephen K.
Broaddus, V. Courtney
Browder, Joseph G.
Brown, Frank R., Jr.
Buchholz, Barbara J.
Buckley, Beverly P.
Buster, J. K.
Carlson, Grady K.
Carney, Michael J.
Cauce, Cesar Vicente
Cederberg, James A.
Clark, Reginald J.
Codi, Michael J.
Cogswell, Neale A.
Cohen, Jeffrey L.
Colgan, Thomas J.
Conley, Carolyn A.
Cooksey, Stephen H.
Cramer, Daniel C.
Crowley, Walter R.
Cullen, Mark D.
Cummins, Constance L.
Dameron, George W.
Daugherty, Charles H.
Davidson, Steven G.
Davis, Dean A.
Davis, Linda G.
Dean, Stuart L.
De Armendi, Juan R.
DeHaas, David R., Jr.
Denny, Timothy P.
Devoe, Leslie A.
Dickson, Clarence H. III
Dietch, James T.
Dobson, Mary E.
Dresser, Michael E.
Drummond, William J.
Duffie, Erin L.
Duncan, Susan Gayle
Duus, Andreas III
East, Christopher F.
Eaton, Norman D.
Edelman, Robert A.
Elliott, Michael H.
Ettinger, Harold W.
Everitt, Daniel E.
Farrell, Gregory F.
Faulkner, Sarah A.
Felder, Clifford E.
Ferracone, Robin A.
Ferree, Nancy A.
Filipski, Jerrold M.
Fisher, Deborah L.
Fisher, Jerid M.
Fleckenstein, Edmund A., Jr.
Fordham, Benjamin C.
Fosberg, Stephen L.
Foushee, Harvey C., Jr.
Foust, Lawrence L.
Fox, Robert S.
Franklin, Richard N.
Freeark, Kristine E.
Friedberg, Michael A.
Fuller, Cheryl L.
Fulton, Janis L.
Funk, Florrie Margaret
Furlong, Janice N.
Gardner, John H.
Garland, Steven
Garraux, James D.
Gentile, Don J.
Gerhard, James N.
Gideon, Clarence J., Jr.
Gilliam, Brent G.
Golan, John F.
Gorman, Michael R.
Goshorn, Barbara W.
Grabner, Robert H., Jr.
Graef, Linda C.
Greene, Michael D.
Guyon, Jeffrey J.
Haefeli, William W.
Halsey, M'liss M.
Hanigan, Helenmarie
Harary, Stuart K.
Haraway, Richard F.
Hargest, Suzanne Hohman
Harris, Stuart I.
Hartwig, Cynthia C.
Haughton, Steven L.
Heberer, Frank S.
Hemsworth, Holly L.
Hendrick, Thomas E.
Henry, Richard Clyde
Herlevich, Camilla M.
Herzig, David F.
Herzog, Paul F.
Hesler, Julie K.
Heston, Douglas C.
Highberger, Elise M.
Hill, John K.
Hinson, Glenn Douglas
Holden, David L.
Holliman, Cecil J.
Howell, Thomas R.
Hudson, Alexandra C.
Hudson, Margaret E.
Hughes, Christine L.
Hunter, Jeffrey L.
Hutchinson, Anne
Ichel, David W.
Jackson, J. Scott
Jackson, John C.
Jarik, Charles L.
Johnson, Alan M.
Johnson, Martha L.
Jones, James B., Jr.
Jordan, Kathryn S.
Justak, Marta M.
Keyser, Willard M. II
Kilgore, Michael A.
King, Charles M.
Klapheke, Martin M.
Klein, Andrew S.
Knobloch, Ellen L.
Kohler, David C.
Korenchuk, Keith M.
Labensky, Steven J.
Lamadriz, Maria C.
Lamb, George C. III
Landreth, Pamela Ann
Lansing, Ann M.
Lash, Roger S.
Lattimore, George M.
Lazar, Cathy Joines
Leatherman, William S.
Lee, Barry W.
Lee, James E.
Legrand, Charlene D.
Levin, Linda K.
Levin, Stephen A.
Lindblade, Eric N., Jr.
Lineberry, Joseph L., Jr.
Littleton, Elizabeth G.
Littman, Andrew B.
Livingston, Katherine W.
Loevinger, Eric H.
Lovejoy, Glenn R.
MacKay, Elizabeth M.
Maher, Robert J.
Margolis, Ezra D.
Massey, Stephen
Mathe, Richard A.
Mayron, Raymond
McCarty, William L.
McCoy, Steven R.
McCracken, Donald E.
McCreary, Charles H. III
McCune, Barron P., Jr.
McGraw, Marsha M.
McKissick, Kurt A.
McMichael, Lawrence G.
Meglasson, Brenda F.
Mesrobian, Caroline I.
Miller, Leslie R.
Milliken, Anne E.
Mohler, Julie Lynn
Morris, James L.
Nelson, Randall J.
Nichols, Virginia G.
O'Callaghan, Pamela G.

O'Donnell, Gale M.
Olverson, Thomas P.
Orzano, Paula A.
Parker, Thomas J.
Parrish, Donald E.
Patow, Carl A.
Patterson, Susan L.
Payne, Leonard K. III
Petrowski, Mary Jane
Pless, Laurance D.
Porter, Mary L.
Porter, Robert S.
Poss, Mary L.
Power, Sara G.
Prince, Marilynn A.
Rader, Kermit L.
Ramirez, Melissa J.
Ransom, Richard Arthur
Raphael, Glenn Douglas
Reiland, Michael G.
Reintgen, Douglas S.
Rice, David T.
Richards, Miriam J.
Ricks, Charles R.
Ricks, Margaret A.
Roberts, Cynthia A.
Roberts, Karen L.
Robertson, Gregory A.
Robinson, Mark R.
Robison, Valerie A.
Rodriguez, Robert A.
Roelofs, Richard P.
Rubin, Alan
Rushing, Ann E.
Salley, Cynthia S.
Saltiel, Alan R.
Samet, Julie K.
Schaaf, Stephen W.
Schach, Paul W.
Schreiber, Ann L.
Schroll, James R.
Schwartz, Amy L.
Schwartz, Richard Allen
Segerlind, Claudine L.
Semmes, Mark N.
Sessions, Teresa R.
Sewell, Allen C.
Shack, William P.
Shavel, Michelle M.
Shore, Steven E.
Showen, James E.
Shuey, James F.
Shutler, David Frederick
Silver, Jonathan M.
Simmons, Gwendolyn R.
Smallhoover, Joseph John
Smith, Bryan L.
Smith, Malbert III
Smith, Raymond J.
Smith, Stuart G.
Snyder, Catherine C.
Spellman, Mark H.
Stanton, Edward S.
Stautberg, Cynthia S.
St. Clair, Jesse W. III
Steeper, Theresa A.
Stevens, Bruce C.
Stevenson, John A.
Stopher, Marilyn
Strott, John B.
Sublette, Timothy M.
Sutton, A. Keith
Swafford, Christine D.
Sweeney, Patricia Alma
Swift, Marie C.
Symington, Jean B.
Tait, Amelia G.
Tanenbaum, David B.
Tatum, Robert K.
Teagarden, Eric R.
Thalmann, Ellen A.
Thomas, Dwight A.
Thompson, Eleanor F.
Toppman, Lawrence C.
Truscott, Thomas R.
Trusty, Margot A.
Tucker, Jalie Ann
Turner, Robert S.
Uhler, Kathryn L.
Vanderwist, Lynn A.
Vinik, Bruce N.
Vinson, Gay Paisley
Visser, Cheryl A.
Wagoner, George R., Jr.
Walchli, Suzanne B.
Waldorf, Leah D.
Watkins, Robert S.
Weaver, Harold A., Jr.
Weiner, Gary A.
Weinheimer, Andrew J.
Welder, Linda R.
Wells, Wade M.
Westman, Dean E.
Weston, Jonathan P.
Whatley, Ralph E. III
Whitman, Daniel Emanuel
Whitten, Louise M.
Wilkerson, Timothy R.
Willert, Alan K.
Wilson, Celeste R.
Wilson, Edna M.
Wilson, Mark T.
Winitsky, Michael A.
Woelfel, George F.
Wojnowich, Leonard S.
Woodford, Eileen V.
Wright, Evelyn H.
Young, James W.
Young, Mark A.

SCHOOL OF ENGINEERING

Freshman Class Honors 1973-1974

Basil Henry Scott, II
Walter Franklin Horne, III
Brian Louis Grundmeier
Paul Morton Wilson
Joan Marcelle Jones
Joel R. Buchanan, Jr.
William Dana Middleton
Richard Montgomery Prevatt, III
Stewart Frazier Stowers
Janis Ann Jordan
Alastair Norman Couper
Margarita Maria Rehbein
Christopher Rowe Mellott
Frederick Ernest Ehrsam, Jr.
John Douglas Millan
Charles Edward Spritzer
Randall Frank Olson
Paul Patrick Thogersen
Cliff Al Younger
Robert Francis Pierry, Jr.
Elizabeth Anne Hooper
Otha Morton Harris, Jr.
Robert Timothy Hyatt
Steven Craig Bartolutti
Michael Scott Albert
Wayne Lyle Poll
Robert Thomas Kraemer, Jr.
Terence Zekon Wong
Hugh Bailey Morris
William Russell Scheirman, II
Robert Smith Burrus, Jr.
Ted Stuart Gansler
Ann Earl Neureuter
Andrew Bonner Kientz
Scott David Deitchman
Brent William Barbehenn
Russell Robert Walker
Frederick Joseph Kretzschmar
Christopher Ken Northup
Keiko Hsu
Thomas Frederick Rahlfs
Marc David Rafal
Mark Raymond Smith

Sophomore Class Honors 1973-1974

Philip Jay Hawk
Gordon Edwin Melville
Walter Winn Hord
Malcolm Tufts Shealy
Beth Ellyn Schwanke
Howard Rhys Taylor, Jr.
Richard Stephen Kram
John Corneliue Lyons
Edward Anapol

Paul Emerson Whittaker
David Gray Boyer
Peter Mercer Johns
J. Andrew Bohn
Geoffrey Gunn
Steve Allen Fris
Stockton Marion Jones, Jr.
Ellen Elizabeth Mack

Junior Class Honors 1973-1974

Kenneth Earl Gerlitz
Scott Rollins Crowgey
Diane Merrill Davidson
David Martyn Wheeler
David Reed Markle
Kent Carlyle Hustvedt
Hugh George Chilton, III
Michael Lewis Halladay
Thomas Edwin Hall
Wade Thomas Cooper, Jr.
David Park McCallie, Jr.
Frank Wentzel Gayle
Billy Edward Kluttz, Jr.
Joseph Alan Rappazzo
David Charles Froehlich
Timothy Paul McClain
Stephen Wayne Hamilton
Charles Stratton Demosthenes
Michael Alan Freeman
Athanasios Demetrious Aridgides
William Lee Shoemaker
Mark Christopher Bussmann
Gary Thomas Brotherson
John Winder Bailey Curtis, Jr.
William Craig Sando
Harry William Prahl, II
Peggy Ann Lawson
David Grimes Autrey
Terry Hohn Krauss
John Cotton Garvey
Dennis McKenzie White
Stuart Forster Cogan

SCHOOL OF NURSING

Freshmen Class Honors 1973-1974

Mary Malvina Alderman
Marcia Lucas Bacon
Pamela Shirley Baker
Gwendolyn Kaye Ball
Regina Ann Boval
Susan Anneen Bowers
Barbara Ann Brennan
Amy Lawrence Brown
Julie Butcher
Sue Carroll
Lisa Ellen Flint
Margaret Anne Forester
Carrie Ellen Goodwin
Dolly Ruth Grant
Geri Lynn Haney
Jean Miner Herbert
Rosemary Hickey
Debra Ann Jones
Roberta Eileen Kaplan
Karen Kent
Paula Claire Kirby
Wendy Louise Koenig
Elizabeth Shelton Montgomery
Kath Jo Noble
Leslie Curtis Sherman
Louisa Douglass Stiles
Helen Elizabeth Sullivan
Marshall Ann Sutton
Karen Elise Timlin
Kathleen Ellen Viall
Cheryl Anne Walker
Katherine Elizabeth Ward
Deborah Sue Wilcox
Caryl Lynn Zolldan

Sophomore Class Honors 1973-1974

Martha Bebb Coyle
Aleta Reynolds Crawford
Linda Marie D'Appolonia
Patti Anne Dolan
Gwen Ellen Gieselman
Debra Denise Gillespie
Sharon Louise Godwin
Anne Elizabeth Guerci
Elizabeth Mary McManus
Pamela Ann Ryan
Beth Victoria Schen
Eleanor Jane Schildwachter
Brenda Jean Shepherd
Sarah Pinckney Smith

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Nancy Lee Anderson
Elizabeth Freeman Baldwin
Linda Ann Bjornstad
Holly Marie Cullison
Lauretta Sue Frederick
Linda Lou Grasmick
Patricia E. Gregory
Lois Hildegarde Heckmann
Miriam Kay Jernigan
Constance Maria Lambur
Karen Ann Leitinger
Patricia Ann Rieser
Leslie Wood Snedaker
Judith Ann Thorpe
Kathryn Lee West
Shelley Dianne Williams

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MAP OF DUKE UNIVERSITY

East Campus

- A Baldwin Auditorium
- B Bassett House
- C Brown House
- D Union Building
- E Faculty Apartments
- F Art Museum, Geology
- G Aycock House
- H East Duke Building
- I West Duke Building
- J Jarvis House
- K Carr Building
- L Giles House
- M Woman's College Library
- N Alspaugh House
- O Pegram House
- P Duke Press
- Q Infirmary
- R Ark
- S Crowell Building
- T Epworth Inn
- U Gilbert-Addoms House
- V Southgate Hall
- W Campus Center
- X Woman's College Gymnasium
- Y Asbury Building
- Z Bivins Building
- AA Art Building
- BB Branson Building

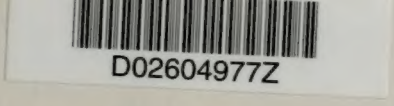


West Campus

- A Duke Chapel
- B Divinity School
- C Gray Building
- D Perkins Library
- E Language Center
- F Old Chemistry Building
- G Davison Building School of Medicine
- H Hospital Main Entrance
- I Gerontology, D & T, Clinical Research
- J Duke Hospital
- K Sociology, Psychology
- L Social Sciences
- M Allen Building
- N Few Quadrangle
- O Craven Quadrangle
- P Wannamaker Hall
- Q Crowell Quadrangle
- R Clock Tower Court
- S Kilgo Quadrangle
- T Union Building
- U Flowers Building Page Auditorium
- V Card Gymnasium
- W Indoor Stadium
- X School of Law
- Y Gross Chemical Laboratory
- Z Biological Sciences
- AA Plant Environment Laboratory
- BB Physics Building
- CC Nuclear Laboratory
- DD School of Engineering
- EE Army Research
- FF Medical Center Research Buildings
- GG Nanaline H. Duke Medical Sciences Building
- HH Warehouse, Shop
- II Bell Building
- JJ Hanes House School of Nursing
- KK Hanes House Annex
- LL Pickens Rehabilitation Center
- MM Graduate Center
- NN Alumni House
- OO Commonwealth-Studies Center
- PP Personnel Office
- QQ International House
- RR Personnel Office
- SS Education Improvement Program, A Better Chance Program
- TT International Studies Center
- UU Campus Stores Office
- VV Office of Institutional Advancement
- WW Information Services Visitors Bureau
- XX Admissions Office
- YY Edens Quadrangle
- ZZ Wade Stadium




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